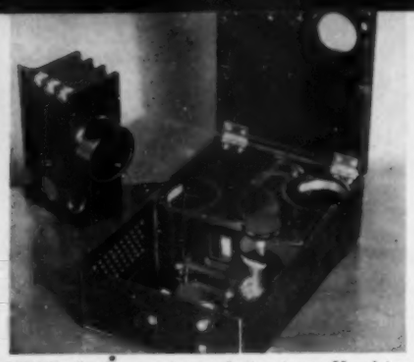
# MODERN PLASTICS

SEPTEMBER 1934

**LESS AND TASTELESS:** One of the examples of these qualities of is the molded cigar tips used by a maker of new and popular cigars.

**STRONG:** No matter how many thousands of times a day heavy hands pound this Bates machine, the Durez frame will stand up—year after year!



**LIGHT:** Lightness is a relative term. Used in connection with this Durez pocket projector it is coupled with strength . . . Durez weighs but a fraction of steel, zinc, aluminum.

**DENT PROOF:** Your soda-jerker isn't handler of heavy ice-cream scoops but they don't dent this molded Dur

**PROOF:** The Durez molded parts Heater are continually subjected to ly boiling water, but they do not egrate.

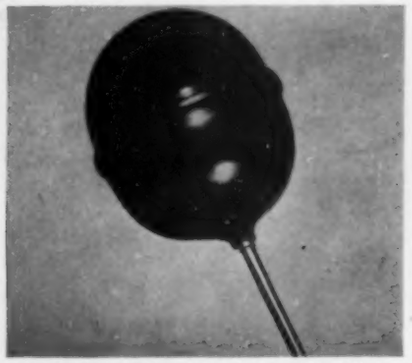
**DIELECTRIC:** Arcing paths caused by grease and moisture prove unavailing against Durez . . . as witness this Mallory Ignition Coil.

**COLOR VARIETY:** Color in Durez is not *surface* finish . . . like lacquer or paint. Durez color does not dull, chip or peel . . . many colors available.

**PERMANENT LUSTER:** Luster is an part of every Durez molding . . . usage cannot dull or efface it.

**ICALLY INERT:** As witness this film oper molded of Durez which must ntinually immersed in potassium salt ons.

**INSOLUBLE IN ALCOHOL:** The Telephone Sanitator, molded of Durez, shows no effect from constant contact with the highly concentrated alcoholic antiseptic which it contains.

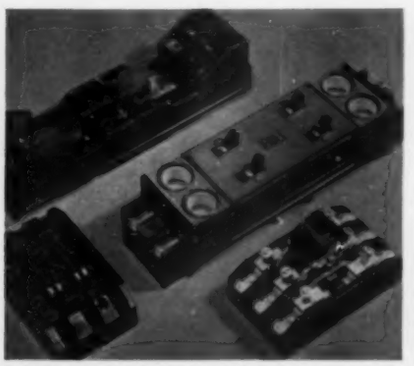


**CORROSION PROOF:** Submerged for life in a water closet . . . what a test! But Durez float balls live through it!

**CHIP-PROOF:** A retail counter-displ a hard life, but this one, molded has proven chip- and dent-proof.

**ROOF:** There will be no bare metal where enamel has peeled off on Durez typewriter parts. For the Durez goes all the way through the piece.

**NEEDS NO POLISHING:** Take a Durez job out of the mold . . . and it's both *made and polished.* For polish and luster are automatically produced in the mold.



**INTRICATE SHAPES:** A single molding operation produces a Durez part complete with fastenings, mountings, and grooves—making a better part and cutting assembly costs.

**SMOOTH SURFACE!** Durez' smooth face is pleasant to touch. And Durez conducts heat slowly, fingers burned when they touch this Durez

# DUREZ

MODERN MOLDING COMPOUND

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VOLUME TWELVE : : NUMBER ONE

# MODERN PLASTICS

SEPTEMBER 1934

*WITH WHICH IS COMBINED PLASTIC PRODUCTS*

Interchangeability . . . . . 17
What Price Molded Parts? . . . . . 21
By John P. Bolin
Statement of Policy . . . . . 22
A Designer Speaks His Mind . . . . . 24
By Harold L. Van Doren
A Cloud No Bigger Than a Lady's Wrist . . . . . 28
A Hostess Looks at Plastics . . . . . 30
By Helen Ufford
With Particular Reference to Laminated Sheets . . . . . 35
By N. S. Stoddard
Lighting the Smart Way . . . . . 44
By Carl J. Begemann
Eastman Introduces a Molded Camera . . . . . 45
Celluloid—Grand-Daddy of 'Em All . . . . . 46
By George H. Boehmer
For Duty and Beauty . . . . . 52
You've Got to Get Contrast . . . . . 54
By Franklin E. Brill
Which Plastics to Choose . . . . . 56
By Herbert Chase, M.E.
No Longer Substitutes . . . . . 68
Dental Hygiene Through Plastics . . . . . 70
News and Developments . . . . . 72
Anent Our Contributors . . . . . 76
Index to Advertisers . . . . . 82

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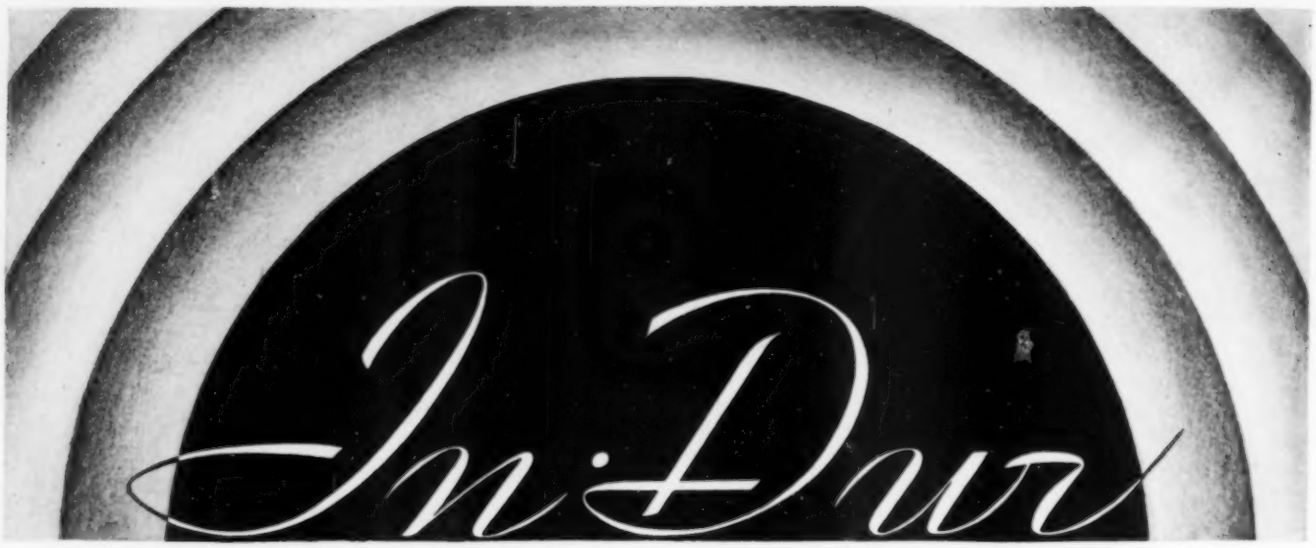


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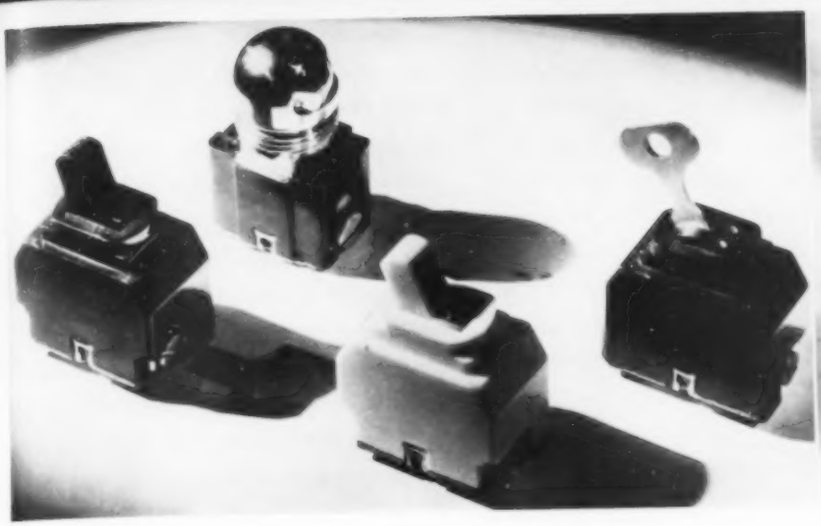
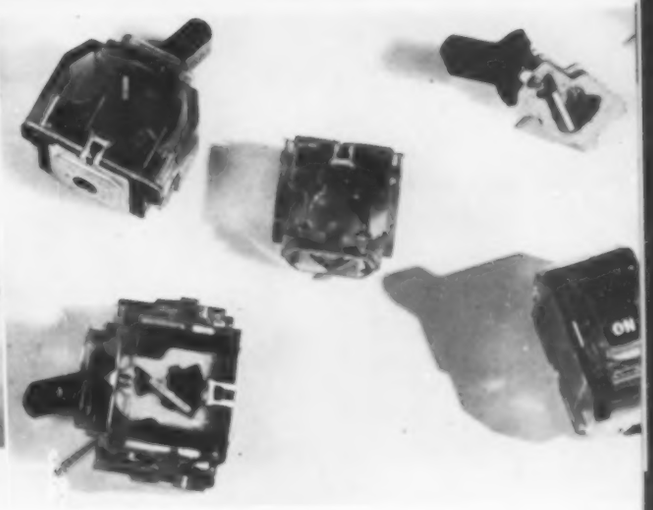




*Left:* Tumbler Flush Switches, Lock Switch, and Pilot Light Receptacle. Three units (the tumbler flush switches are duplicates in Bakelite and Plaskon). The switching mechanism has a four-point break to insure against breakdown from overloads. Conforming to the most rigid Government and architectural specifications, every switch is tested under full load current

*Above:* Tumbler Flush Switches. A transparent molded plastic (Tenite) encases but fully discloses the tumbler flush switch mechanism. The operating principle and the sturdy construction are both disclosed to the credulous buyer. (A modern plastic possibility of equal promise to many other industries and displays)

# INTERCHANGEABILITY

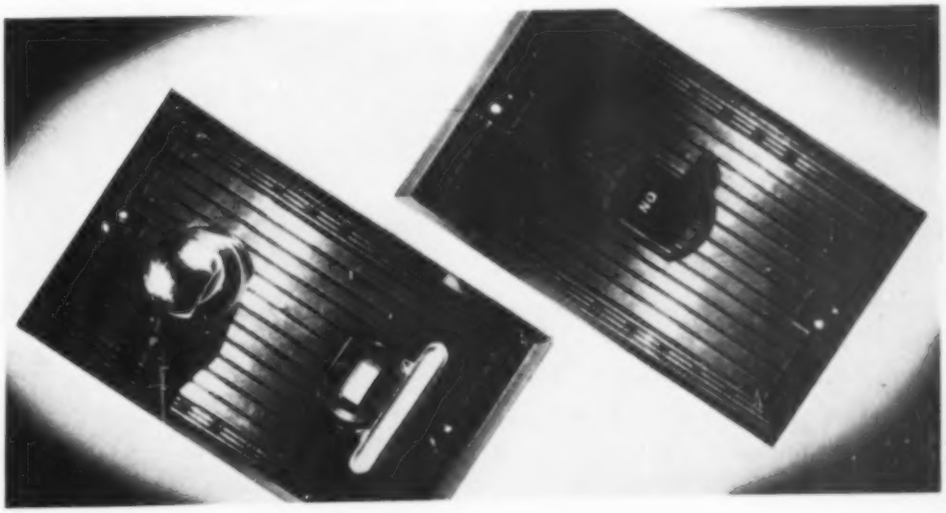
## 23 BASIC WIRING UNITS GIVE 59,244 COMBINATIONS; GIVE MOLDED PLASTICS A WIDER OPPORTUNITY IN THE ELECTRICAL FIELD

Ingenuity and invention, catalogued under a name as prosaic as Patent Number 00000 might often be classified under another term. This term is: ANTICIPATION. Pass & Seymour, in devising the new Despard line of wiring devices (named for Victor R. Despard, who supervised the development of the line), anticipated the changes which they felt were necessary for electrical fixtures in both the modernization and the new building market. At the time work was started on the new line it could hardly be said that there was either a modernization or a new building market. Today, however, thanks to the Government's attempt to inject some life into the housing and building of the country, both markets are opening. In opening, new conditions have to be faced and new methods of facing these conditions must be developed.

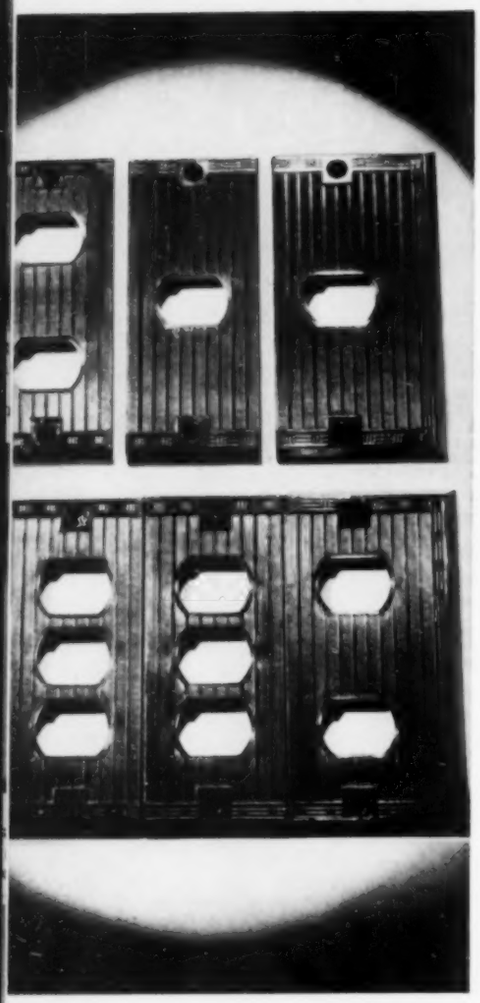
Here is a development that is strictly in trend with the times and a highly valuable solution to the problem of wiring. In observing the Pass & Seymour Despard line in its entirety, it will be noted that each unit is fabricated from either a urea or a phenolic plastic—Bakelite and Plaskon being interchangeable throughout the line. Pass & Seymour chose molded plastics for various reasons. First of all, they gave a completely matched installation wherever switch and wall plate of the same color were desired. Of course, the possibility of color combinations using an ivory switch panel and a deep brown switch were not overlooked. Both features were advantageous for molded plastics.

The dielectric advantages are obvious; so are the absolute safety of these plates and switches as far as static electricity, generated on rugs within the rooms where the installations are made, is concerned. The size and weight are greatly reduced, meaning that the compactness of outlets and pilot lights consume less than 50 per cent of the space formerly devoted to wiring devices. The plates are strengthened by slightly increasing the thickness and by shifting the holding screw holes to the edge of the plate. The objection to constant use of metal polish on brass plates in office buildings leading to the spotting of the painted surface around the plates is completely overcome, because polishing of the plastic plates is unnecessary.

From a manufacturing standpoint production costs are lower and these costs are reflected in the purchase price to the ultimate consumer. The possibility of styles and



Single Switch Panel, Bell Push, Name Plate and Night Light Panel. Molded plastic wall plates offer advantages. Structurally they have thick, strong sections and the wiring device strap with each plate forms a metal backing and reinforcement.



Extension Units in Wall Plates. On and on and on can these sectional plates continue. Here are shown the end units and a single central section (which can be enlarged to any necessary number, and necessary outlet grouping, separately, and in unison)

Single and Gang Plates in Bakelite and Plaskon. The simple dignified face styling is in keeping with the modern trend away from high ornamentation

designs is unlimited, as is the same feature in color, except by the standardization limits which keep the line to a minimum number of pieces, thereby allowing the jobber the opportunity to carry a complete stock without a large inventory. For display purposes showing the action of the mechanism, Tenite casings have been cast, as shown in the photograph on page 17.

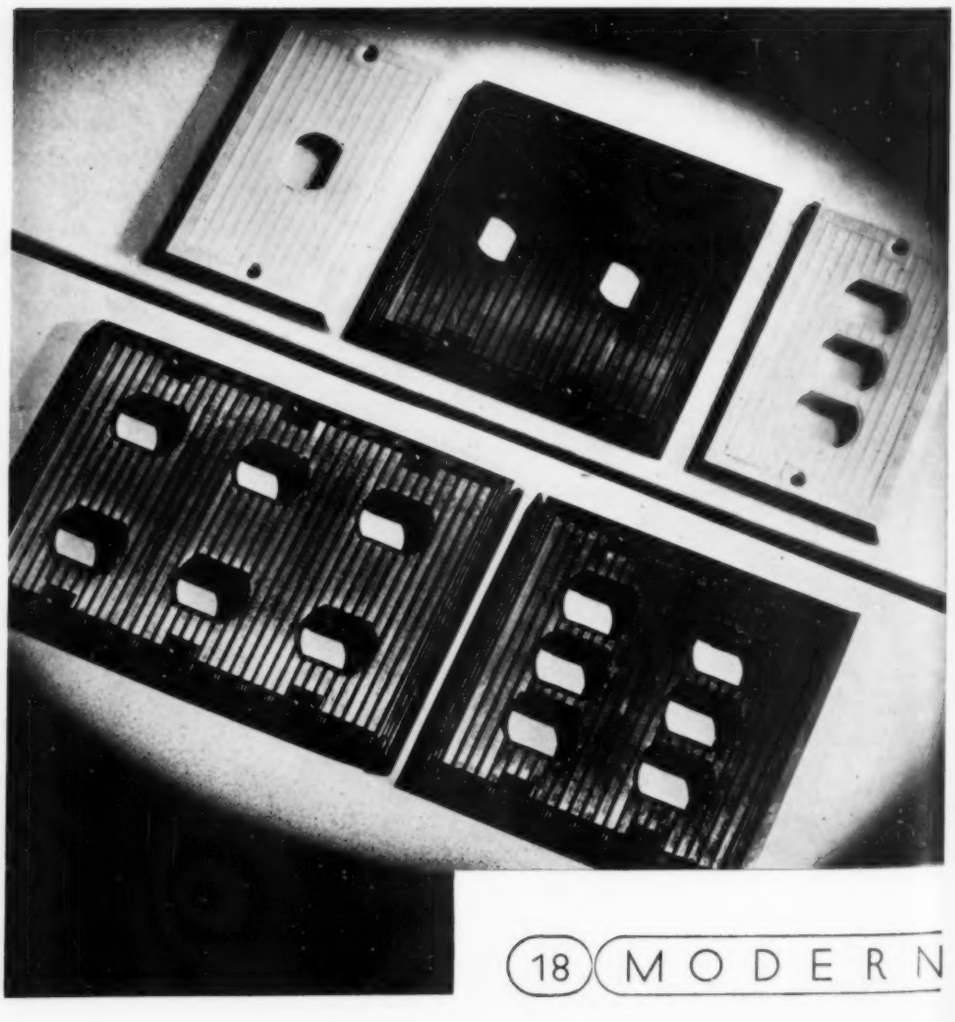
The four Pass & Seymour Despard switches embody a principle which enables them to successfully resist the deteriorating effects of the punishment which is given switches today by the tremendous initial surge of current from cold lamps. The shutter or contact disc in these new switches travels with lightning-like speed as it makes or breaks the current. The shutter, made of laminated phenol resin, has brass buss bars on each side. As the shutter travels through its path it enters U-shaped phosphor bronze contacts whose natural position is such that they must expand to permit the entrance of the shutter. This expansion on entrance and contraction on withdrawal makes a full wiping contact insuring clean contacts at all times. In addition, this feature prevents chattering of contacts which is conducive to contact deterioration. As the shutter leaves the U-shaped contacts, a follow-through action of this disc snuffs any arc which might be present.

It is interesting to note in the single pole switch the break occurs at four distinct points as contrasted to the customary two-point break of previous types of switches. By this feature the amount of current which each point must handle is reduced by one-half, thus greatly relieving the strain on the contacts and the arcing present in the switch.

The features which the most strict Government specifications on switches call for are included. An enclosed phenol resin housing makes them practically dust-proof. A yoke doubly insulated from current-carrying parts insures safety. A full-sized, sturdy molded plastic operating handle means easy switch operation.

Any switch can be easily converted to a lock switch by assembling a lock hood to the face of the wall plate. This lock hood is fastened to the plate by screws inserted from the rear of the plate. The outlet line consisting of a convenience outlet, a radio outlet and a convenience outlet designed for pilot light control, all embody a new contact principle. The bronze contact fingers are designed so that as the attachment plug is withdrawn from the receptacle the arc created by the break is far removed from that section of the contact fingers which supplies the tension and spring to the contacts. This insures the elimination of loose and tensionless contacts. The face design of all three outlets is identical and is such that attachment plug blades easily find their way into the contact slots.

Pilot lights and night lights are equipped



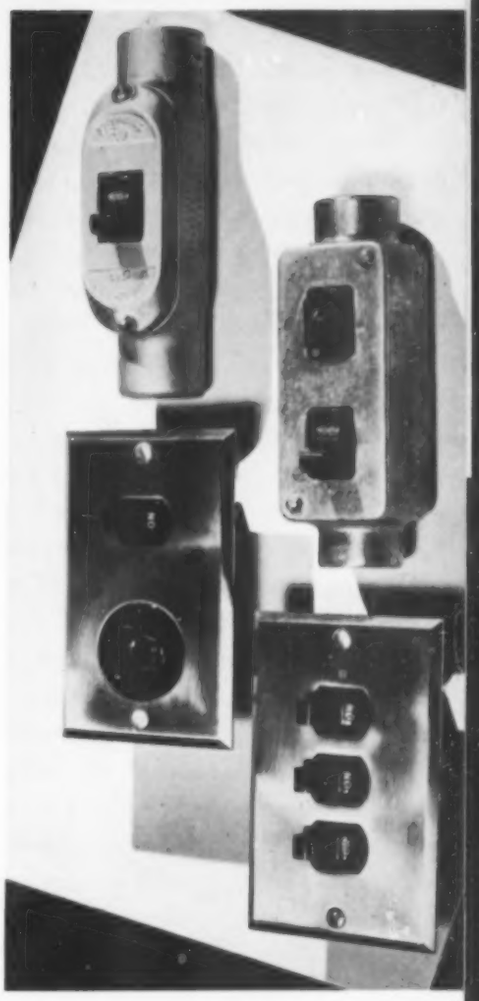
with 110-volt, 6-watt Mazda lamps which give a more brilliant light and generate less heat than the carbon lamps customarily furnished with pilot lights. It will be observed that the heat generating section of the lamp is located above the surface of the wall plate so that the heat is dissipated through the openings in the hoods. When a pilot light or night light is combined with a switch the life of the switch is not affected by the presence of excessive heat. Lamps may be easily renewed without the removal of the wall plate.

The general theme of the plate design is elegant simplicity, lending distinctiveness and dignity to any building. The field of the plate is etched with light lines, interrupted periodically with a slightly broader section running longitudinally, giving a ribboned effect to the plate. A conservative border which is correctly subordinated to the field encloses the field.

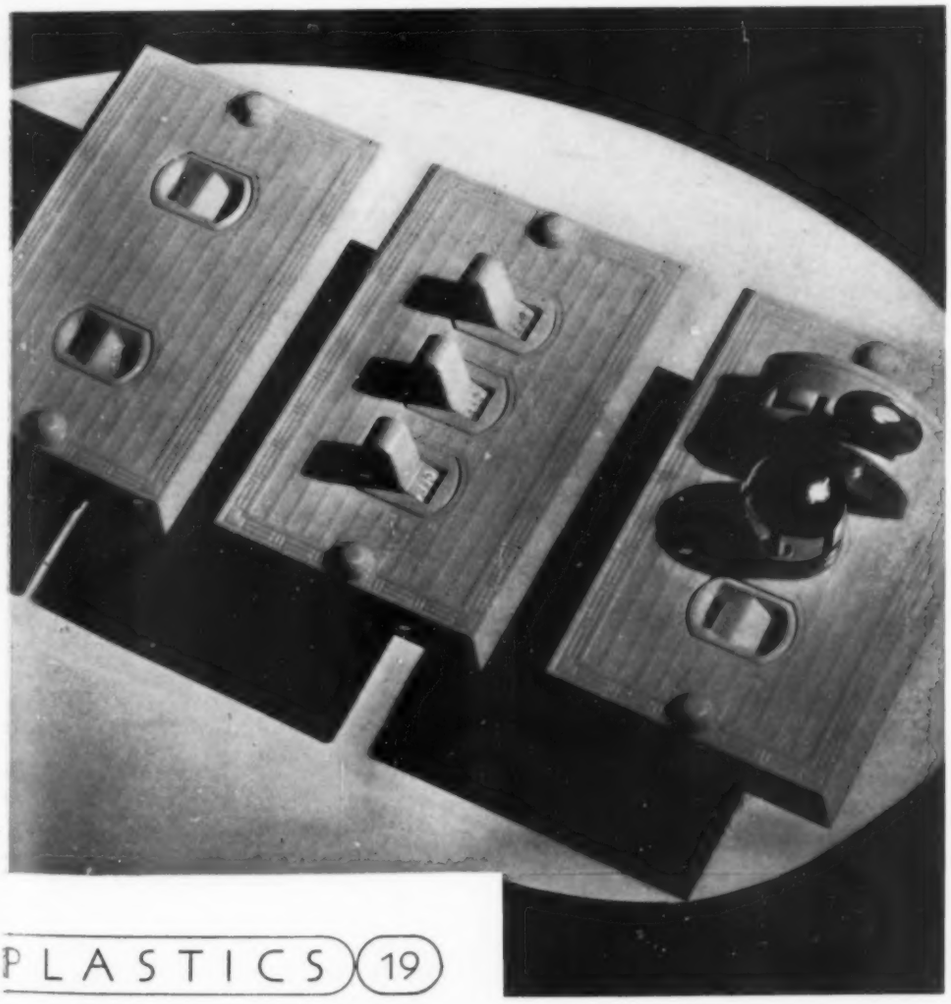
The entire plate line consists of only seven plates which are manufactured in two colors: brown and Alabar (ivory). With these two smart colors available the necessity for brass plates and their many troublesome special finishes becomes needless. The brown plates will be used in the greater portion of the residence and commercial building, but in those rooms where something even nicer is desired the Alabar (ivory) plates will be installed.

The method of fastening individual devices to the mounting strap is unique. By inserting a device through the strap opening or porthole, and by four quick twists of a screwdriver inserted into the small slots, the device is tightly anchored in position. The necks of all devices are uniform in size and consequently can be located in either of the two straps. Only two device straps are necessary. One strap is provided with one opening to accommodate a single device and the other strap is designed with three openings to accommodate either two or three devices. One or the other mounting strap must be used in each gang box.

Summarizing the line as a whole, it features simplified, modern design with duplication eliminated by the selection of 23 basic devices and wall plates which can be used in any combination necessary in the wiring field. The jobber finds the line not only easier to handle because of its simplicity, but the investment necessary to keep a representative line is greatly reduced and his inventory turn-over greatly increased. Prompt service is easier, and wiring costs correspondingly reduced. The devices are purposely small but very sturdy. They have the full 10-ampere rating for switches, 15-ampere rating for outlets, and are listed as standard by the Underwriters' Laboratories. The possibilities in home modernization alone are tremendous at this time. The public has become so dependent upon the



Combination. For some industrial and commercial installations metal combinations can be used advantageously. Here are conduit and switches with molded plastic switch and plug units installed. Often it is possible to expand services from present outlets by purchasing new covers designed to take the standard molded plastic unit

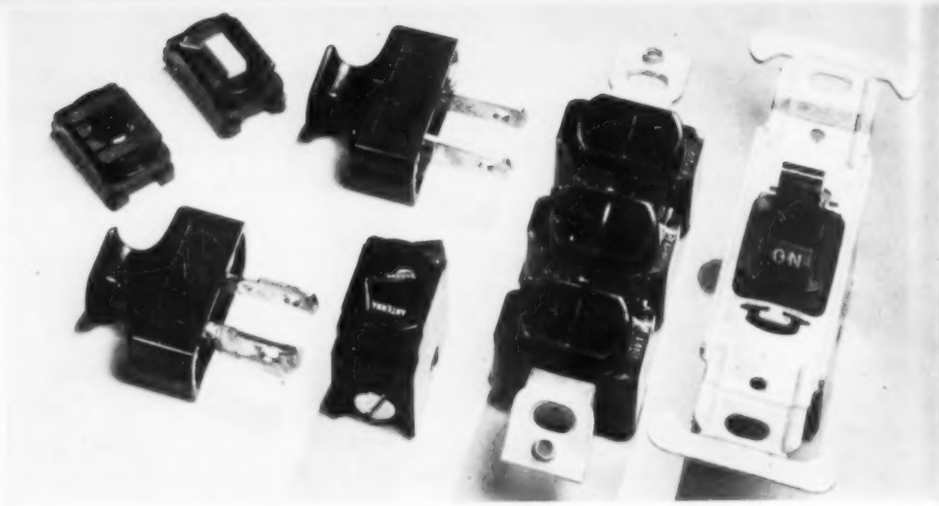


Soft Ivory, Easily Cleaned Ivory, Permanent Ivory. Units in this light color Plaskon show to advantage the wide possibilities of molded plastics. The screws, located at the outer edge, are of the same color—or contrasting brown, should this be desired

electrical devices and electrical outlets that the home built as late as the early '20's is inadequately wired to care for the many electrical appliances being used. Living-rooms are covered with cords weaving their way under rugs and around furniture, finally to each radio, bridge lamp, or electric fan. The kitchen is a woeful example of the inadequacy of present installation. Three or four rickety current taps which would seem to refuse to stay plugged into their sockets are the inadequate means of serving smart modern kitchen appliances. Pass & Seymour realized that if electrical wholesalers were to continue an active interest in wiring devices, if electrical contractors were to become interested merchandisers of wiring devices and if the public were to become wiring device-conscious, it would be necessary to develop radically different wiring devices than were being manufactured. The problem was analyzed and concluded to be due to a vast unnecessary number of wiring devices — many of which were functionally duplicative — leading to excessive investment and slow turnover, resulting finally in profitless sales to the wholesaler and contractor. It was only natural to infer that profitless sales deadened enthusiasm and loss of enthusiasm meant lack of aggressiveness. Such a condition of indifference was realized to be detrimental to the health of the wiring device industry and to the advancement of improved standards of wiring.

Within recent years the electrical industry has been endeavoring to convince the public that additional outlets, added switches, a pilot light wired in combination with an outlet or switch provided more comfort and convenience in the home. The industry unfortunately has been handicapped from the beginning by the lack of products which embodied popular sales appeal, lack of products which would quickly attract the home owner's eye, and by the deplorable fact that what convenience devices did exist were prohibitive to average pocketbooks. So the problem was, first, to create radically different products; second, such products, whatever they might be, must have sales appeal, and, third, these new products must in some way cost the public less to install. The answer to this conundrum was not simple, but its solution seemed sure to be the answer to the general apathetic attitude toward wiring devices. The solution to the problem was finally discovered in the form of a group of wall plate merchandise which could be interchangeably combined to make any combination of wiring devices desired.

To design and *(Continued on page 78)*



Mounting Strap and Switch, Mounting Strap and Gang Outlets and Plugs. The method of fastening individual devices to the mounting strap is unique. By inserting a device through the strap opening (port hole) and by four quick twists of a screwdriver, inserted in the small slots, the switch is tightly anchored in position. Notice the radio plug, marked "antenna and ground." Notice the angle of the slot, and the companionate angle of the inserting pieces, insuring against antenna in ground or vice versa

Display. Compact, convenient, tight, and attractive case, showing all of the 23 units—also some of the units in combination with metal plates, Plaskon and Bakelite and interchangeable in the 23 units. Are serviceable and colorful in all combinations

# WHAT PRICE MOLDED PARTS?

*BY JOHN P. BOLIN*

Quotations on plastic molded parts are often misleading to the purchaser because he has supplied the molder with insufficient information on which to base his quotation. This lack of information forces the molder to guess what is wanted, and if his guess is incorrect his quotation will also be similarly out of line.

When requests for prices are made to more than one molder, and each molder makes a different guess as to what is wanted, the result is so wide a variance in prices that the purchaser concludes no molder knows his costs. If the purchaser will supply, in addition to a blue-print or drawing showing dimensions and allowable tolerances, information as to the purpose of the part; his probable yearly, monthly or weekly requirements, and the quality of finish desired, there will be no misunderstanding and no need for guess work on the part of the estimator.

The first thing necessary to produce molded parts is a mold. The capacity of the mold is an important factor in arriving not only at the price of the parts to be made but also the rate of delivery of these parts which may be expected.

The number of cavities in a mold—that is, the number of parts made in each operation of the mold—controls the operator's time. When running a mold with only one cavity, but one piece is made each time the mold operates and approximately 10 pieces can be made each hour from this mold. It therefore takes 100 hours to make 1,000 pieces. If the mold had been designed with 10 cavities, making 10 pieces each time it is operated, approximately 100 pieces could be made each hour and only 10 hours would be consumed in making 1,000 pieces, thereby saving 90 hours of labor. A worthwhile saving, as on small parts it can be considered that labor generally outweighs material cost.

PIECE COSTS IN QUANTITIES FROM DIFFERENT CAPACITY MOLDS *

| | Size and Type of Mold | | | | |
|---|---|---|---|---|---|
| | 1 Cavity Hand Mold | 6 Cavities Hand Mold | 12 Cavities Hand Mold | 24 Cavities Hand Mold | 24 Cavities Semi-Aut. Steam Mold |
| Approximate Daily Production | 80 | 450 | 840 | 1,560 | 4,100 |
| Cost of Mold | $125.00 | $500.00 | $850.00 | $1,500.00 | $1,700.00 |
| Piece cost per 1,000 | 170.00 | 42.00 | 29.00 | 22.00 | 20.00 |
| Total cost mold and pieces, per 1,000, in: | | | | | |
| 1M quantities | $295.00 | $542.00 | $879.00 | $1,522.00 | $1,722.00 |
| 5M " | 195.00 | 142.00 | 199.00 | 322.00 | 360.00 |
| 10M " | 182.50 | 92.00 | 114.00 | 172.00 | 190.00 |
| 25M " | 175.00 | 62.00 | 63.00 | 82.00 | 88.00 |
| 50M " | 172.50 | 52.00 | 46.00 | 52.00 | 54.00 |
| 100M " | 171.75 | 47.00 | 37.50 | 37.00 | 37.00 |
| 500M " | 170.25 | 43.00 | 30.70 | 25.00 | 23.80 |

Note that the 24 cavity steam mold costs very little more than the 24 cavity hand mold but produces more than twice as many pieces per day. Note also that when taking into consideration total costs (that is, mold cost plus piece cost), it is economical to use a 6 cavity mold when quantities run from 5M to 25M pieces. That in 50M quantities the 12 cavity mold is most economical and in 100M lots the price is the same from either a 24 cavity hand mold or a 24 cavity steam mold but the latter has greater daily capacity. In 500M lots the 24 cavity hand mold is not only most economical but insures more than twice the daily production than obtained from the 24 cavity hand mold.

* These figures are actual for a hypothetical case.

Naturally a mold of 10 cavities costs considerably more than a mold of one cavity, and there is no object in making a 10-cavity mold unless the purchaser's requirements for pieces warrant it. Therefore it is advisable to determine as closely as possible what the yearly, monthly and weekly requirements are. With this information at hand the estimator can determine the size mold (number of cavities) necessary to take care of these requirements on the most economical basis.

The number of cavities to put into a mold is determined not alone by the number of pieces to be delivered at a time, but is also governed to some extent by the size and shape of the piece, the kind of material of which it is to be molded and the size of the press in which the mold is intended to be operated.

Mold costs and piece costs are figured separately, and any comparison of quotations from several bidders should be on total cost per 1,000 pieces in quantities expected to be used, with the mold cost spread over these quantities.

The figures shown in the accompanying table illustrate the wide variance in total piece costs, made possible by quoting on the same piece but in different quantities and from molds of different capacities. These are actual figures, but for a hypothetical or imaginary piece.

Sometimes it is advisable to consider only a single cavity mold until the market for the piece has been definitely determined, or when developing a new article and there is any question as to its final size, shape or design. If, after trial, it develops that the original idea is absolutely correct and a larger market than originally figured is established, the single cavity mold can be replaced by a mold of larger capacity with little loss. It is even possible in some cases to salvage and use part of the single cavity mold in a larger one.

Because the mold represents a material part of the ultimate cost, its design and construction should be entrusted only to those thoroughly familiar with cold molding practice. A well designed mold built by experienced tool-makers will deliver from 20 per cent to 50 per cent more pieces in a given time than a poorly designed and constructed mold, with a consequent saving in costs. Pieces from a well designed and *(Continued on page 78)*

# STATEMENT

The plastics industry is 66 years old. In three generations it has conquered technical difficulties and overcome worldwide inertia—a progressiveness which indicates unquestionable virility.

Yet at 66 the plastics industry is in its relative infancy. Long vistas of progress—technical and commercial—lie before it. For the thousands of plastic parts that are manufactured today, there will be hundreds of thousands of articles molded in the near future. For the dozens of plastic materials today, there will be scores of even more highly developed materials in the future.

It is this vision of progress possibilities that leads us to the publication of this new type of industrial magazine. It will be our objective to interpret to industry at large the growth of the plastics industry—to point the milestones of the trail which the plastic engineer blazes and to bring to the manufacturer of plastics an interpretation of the desires and the needs of the consumer and the potential consumer.

We shall endeavor to increase the use and consumption of the materials commonly grouped as Plastics. But in this endeavor we shall not limit ourselves to the presentation of already existing materials and uses. We believe that the continued growth of the plastics industry will depend largely upon the skill and speed with which it reacts to opportunities for growth, and we shall therefore make it our primary function to discover and present such opportunities by means of market studies and the intensive investigation of style trends and consumer desires. Our function, as we see it, will

# OF POLICY

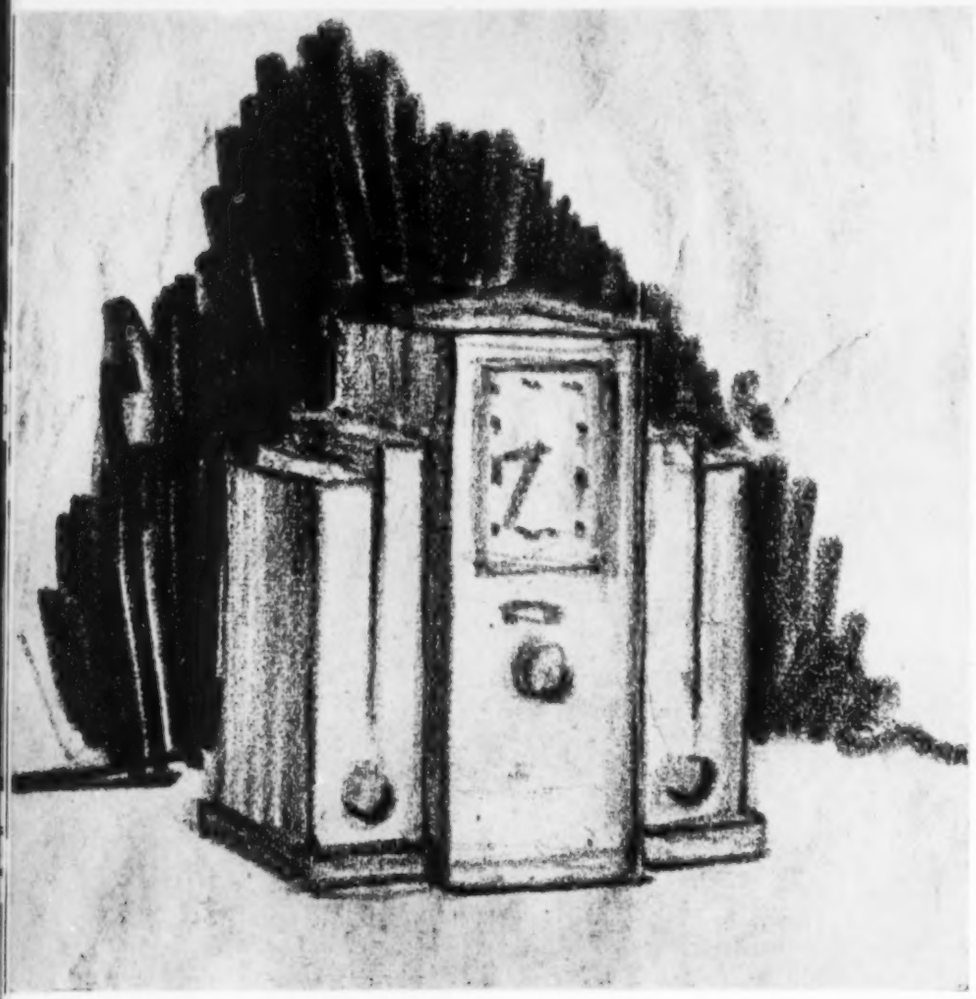
be to serve as a clearing house between the needs of the plastic consuming industries and the ingenuity and inventive skill of the plastic producers. In this aim we have secured the active cooperation of most of the leaders in and associated with the plastics industry. As individuals and as corporations they will make easy our presentation of the industry's side of the picture. It is in the completion and perfection of the other—the consumer's—side of the plastics picture that we invite your cooperation. It is from you and only from you that we can learn, interpret and transmit your needs. So much, then, for a statement of our aims and our intentions. As you turn these pages, you will find in each article a further indication that this is to be a new, a different, a vital and intensely interesting magazine. We present to you MODERN PLASTICS—a foretaste of the future of an already great industry.

D. E. A. CHARLTON,
Editorial Director

CHARLES A. BRESKIN,
Publishing Director

JOSEPH SINEL BY ADAMS-STUDI

We believe format to be an exceedingly importan element in the adequate functioning of a magazin and especially so in a trade publication whic should be planned so simply that nothing shoul detract from copy and illustration. With this ide firmly in mind, we decided that MODERN PLASTIC should have the advantage of a carefully conceive and developed format. We engaged the services o JOSEPH SINEL—noted industrial artist—and we be lieve Mr. SINEL has helped us present to the Plas tics Industry one of the most distinguished indus trial magazines ever produced. Mr. Sinel ha planned the formats of several periodicals an many industrial books. He has been associate with such outstanding authorities as Edwin Grabhar of San Francisco and Elmer Adler of New York. I MODERN PLASTICS we believe the pages are so simpl and direct as to permit one to look easily at th subject matter without attention being distracted b stunt or vogueness in headlines or decoration. W believe business men will welcome this straightfo ward presentation of a courageous editorial polic and vital articles and news of the Plastics Industr



# A DESIGNER SPEAKS HIS MIND

BY HAROLD L. VAN DOREN

At just what moment the designer entered the synthetic plastics field, I do not know. But it was almost too late.

Here was a new material, not wood, nor stone, nor metal, but with qualities all its own, a fine feel and rich texture. It had been on the market in various guises for years before its special qualities were given a chance. It had been tortured into colors and shapes intended to imitate almost anything but itself. The result was that it was branded as an imitation, something spurious and a little dishonest. It was not the material, but the treatment that was dishonest. That strange, almost pathological desire of manufacturers to "imitate" something else was almost the death of a perfectly good industry—at least in its non-industrial phases.

The first good design in a molded plastic that I remember was a powder box. It was molded in a black phenolic resin, devoid of ornament save that the cover was stepped up in shallow concentric rings. It bore a small triangular silver label on the side. I believe it is still in use, and it deserves to be, for it is one of the best designs ever done in a plastic material.

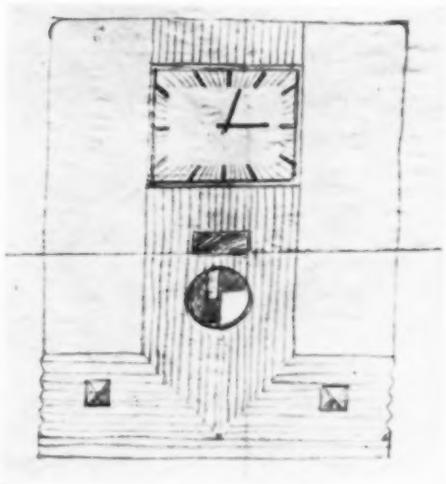
I do not mean to suggest that plastic design must be limited to geometric shapes, and that ornamental enrichment is taboo. In fact, the tendency is rather the other way. The reason for this is partially economic and partially a gradual change of taste. Four years ago, when we first began designing for the plastic industry, mold cost was frequently the factor which made the purchasing department turn its back on synthetic resins for consumer items. Material and finishing costs might be cheaper, but if the quantity were not great enough to warrant high initial mold costs, the price pendulum frequently swung away from the plastics.

Because of this, the early designs from our studio usually employed design forms such as steps, ribs, circles, flutes, etc., which could be machined in the mold with the minimum of hand labor. If more complicated decoration were indicated, or desired, we had to bear in mind that whatever appeared in the finished piece had first to be carved in a steel, in reverse. The labor involved in this boosted the cost rapidly. If a multiple mold were to be made, it was not such a factor, because a single hob could be prepared and several impressions made from that. But if the mold were only a single cavity, then a wax model had to be prepared, a hard plaster cast pulled from the wax, the design then roughed out on a Keller machine, then laboriously finished by hand.

Today the picture is somewhat different. The amelioration of the economic situation, the loosening of money, have made mold costs less of a factor.

Speaking of mold technique, I can remember the time when we were cautioned never to leave a broad, flat surface on a molded piece. We were told to break it up by means of pebbling, or scoring, or sandblasting the surface of the mold. This was especially true in designing for the light-colored urea resins. The reason was two-fold: it was difficult to control flow marks, and imperfections such as specks of dirt were less noticeable if the surface were rough.

Fortunately the designer has much greater freedom now. Molders heretofore accustomed to handling only dark-colored



resins are now equipped to handle the delicate pastel shades without fear of contamination. And they have learned tricks in mold construction which obviate flow troubles—not to speak of the superior molding qualities of the materials.

The fluctuations of taste are even more interesting. It was only a few years ago that the simplicity of the modern style began to penetrate to the consciousness of

the vast majority of executives. Spurred by the so-called class magazines, with their insistence on the simplicity of milady's furniture and accessories in Park Avenue penthouses, we began to get demands for "something modernistic."

To the designer, the word "modernistic" is always a secret laugh. He knows that the termination "istic" means spurious, fraudulent, imitative, or debased. When he speaks of Hellenistic art, he means that period of art history a couple of centuries after the Periclean age when the fine perfection of the greatest Greek work had been softened and cheapened until it was no longer art, but a debased imitation of the real thing. Therefore, if we must have something new in the way of an artistic style, for Heaven's sake let it be "modern" and not that cheap imitation of modern called "modernistic."

The trouble is that modern design is one of the hardest styles in the world to handle successfully. It has no tradition, and no rules of thumb. The architect who designs a post office in the style of a Greek temple has hundreds of examples to guide him. He knows just where the entasis should come on the columns, just what the ratio between the height of the architrave and the pediment should be. If he doesn't, he can find out.

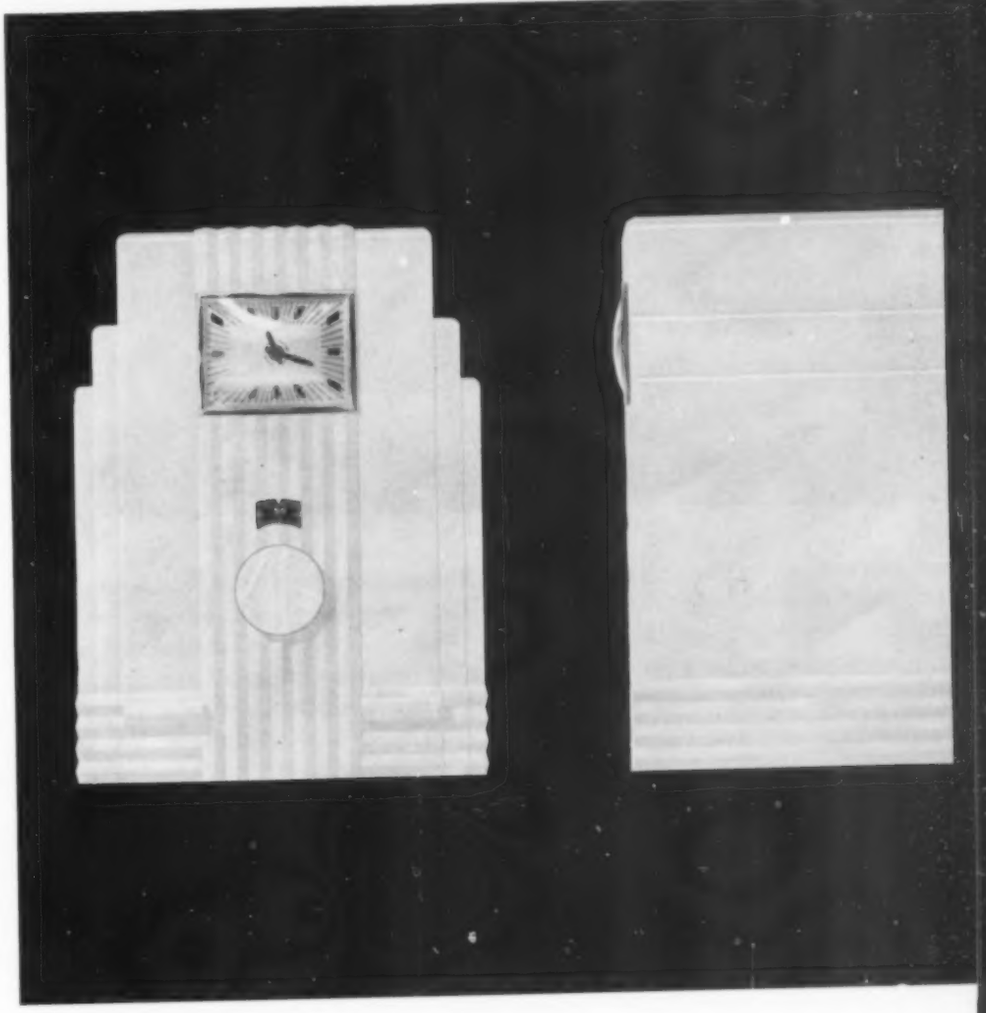
The designer in the modern style has only his eye and his judgment to guide him. The rules and regulations have never been codified. Maybe they never will be. He must have taste and nice discrimination if he is going to get away with it.

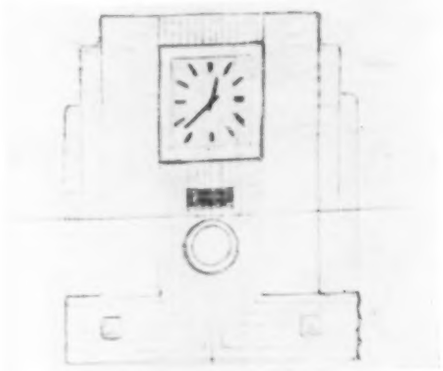
It is my unhappy duty to report that the great majority of modern plastic design is, unfortunately, "modernistic." It is an imitation of the real thing, a debasement of simplicity. It has miserable proportions and misplaced detail. It is usually a meaningless collection of angles, steps, applied plates and the rest of the garbled baggage of Hack Street.

At the moment the tendency seems to be away from the asperities of the modern style, perhaps just because it has been so badly done. The public seems to want more variety of ornament. In Sweden they are slowly evolving a decorative style which is rich, without being fussy, simple and beautifully proportioned. Our own designers should cast about them and see what American motifs they can find, perhaps from Mayan art, perhaps even from the simple weaving of the Navajos.

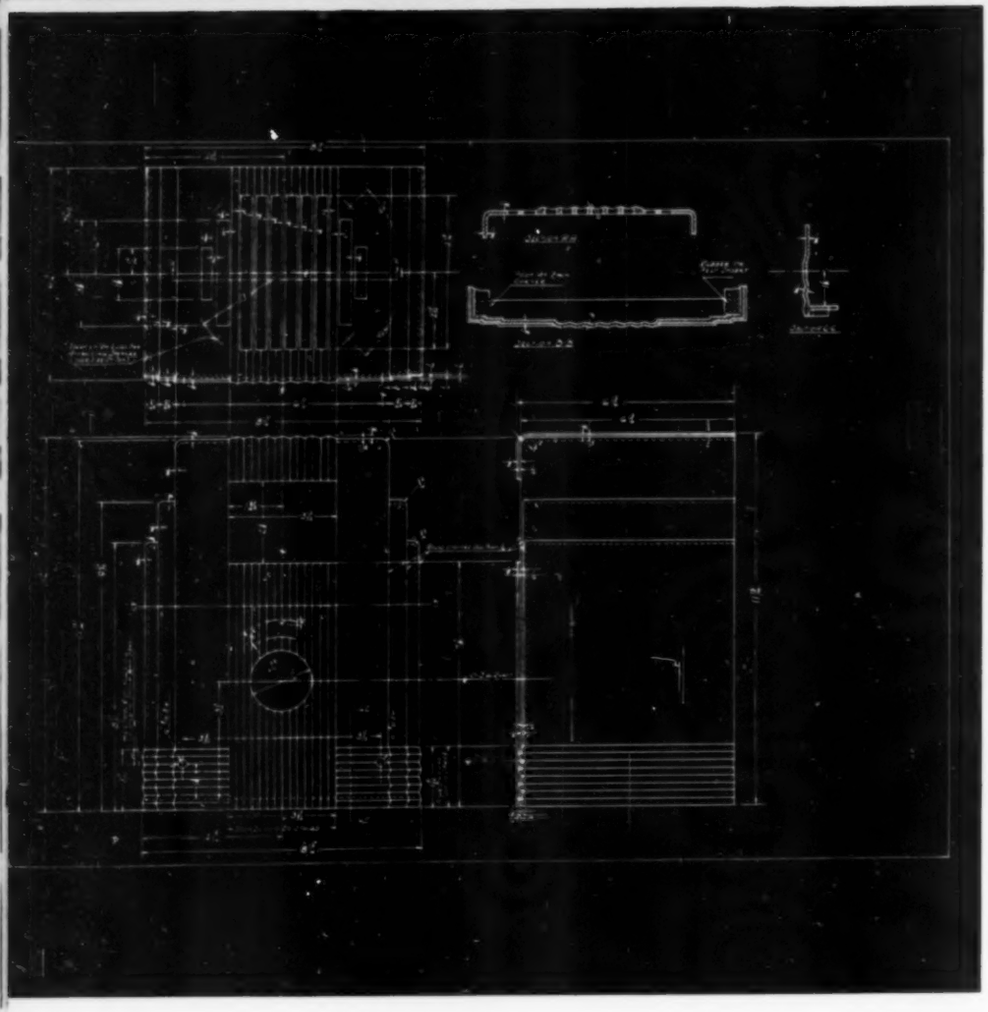
Why have we had so much fake modernism? Dare I tell? It is because the manufacturer is not willing to pay the price of good design. He still thinks that he can get something for nothing. There are a dozen first rate designers in the country who combine taste and a high order of artistic talent with a knowledge of the technical processes involved in the production of good plastic design. And yet the manufacturer thinks he can cut corners by buying a few random sketches from any local commercial art hack for twenty-five dollars apiece, then turning them over to his drafting department or to his molder for execution.

He may pay through the nose for legal consultation, because he knows he will be money ahead in the end. He may appropriate hundreds of thousands for advertising, because the public must be made aware of his product. But what about the poor product? Is any old treatment good enough for it? The pro-





FOLLOW THESE ILLUSTRATIONS and you follow the designer's plan of work. On the opposite page you see the first rough sketch, merely the visualization of an idea. The two small illustrations are the designer's refinements of his original sketch, in which changes have been made for greater beauty and increased practicability both from a use and from a molding standpoint. Above, the final wash drawing—a rendering in full detail of the finished—though yet unborn—radio cabinet. On the next page is the detailed blueprint submitted to the die-maker for use in creating the molds, and on the page following the finished radio. So, too, follow the process, from first rough sketch, through clay model to finished molded pieces, in the creation of a set of grotesque toys.



cedure seems to be to go out and buy a drawing. Any drawing. Then let the drafting department do its work and pull it around into shape.

The reason for this faulty logic appears to be this. The average business man is completely at sea when it comes to drawing. He will tell you so—"I can't draw a straight line," he usually announces. Therefore, he is lost in admiration for anyone who can make any kind of recognizable sketch. The most ordinary brand of manual dexterity with a pencil astounds him. The finer shades of proportion mean nothing to him, for he has no background against which to judge them. Therefore any neatly executed drawing with a bright touch of color seems to him like a miracle. If he can buy one for twenty-five dollars, he feels he has made a good deal, and got the best that money can purchase.

The unfortunate truth is that he usually has bought a pig in a poke. Perhaps a brief outline of the procedure of the authentic industrial artist will serve to show why his economy costs him dearly in the end. To begin with, before attacking a problem in design, the designer gathers all the material he can find which may be pertinent to the finished product. He discusses the matter with the executives, the sales and advertising departments, the engineers, in fact everybody who is involved in the production and marketing of the product. With the aims to be attained well in mind, he makes rough sketches and submits them to the interested parties.

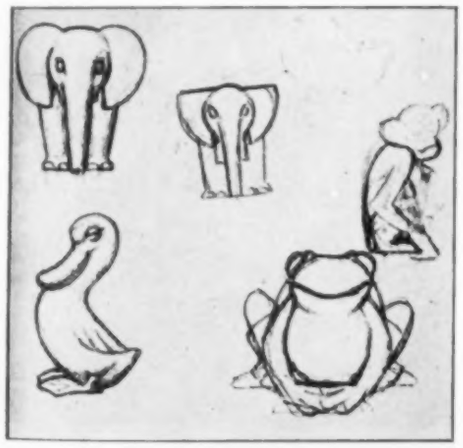
As every good industrial designer is something of an inventor, he may have some entirely new solution of the problem to offer. Perhaps it clicks, perhaps not. But before the rough sketch stage is over he knows the product and its possibilities it may have pretty well.

He then proceeds to work the design up to a more finished form. His own engineers check with the client's engineers for production practicability. When the final form of the design is determined, it is presented to the client in the shape of a perspective visualization, rendered in air brush, water-color or black and white, or in a finished wood model. Many studies

in wax may have preceded this. Dozens of sheets of sketches of the whole or the parts may be over the dam.

When the final O.K. is given, the designer's draftsmen make carefully dimensioned drawings which serve to interpret the design (in all aspects which have to do with visual appearance) to the engineering department of the client. He takes no chances that some draftsman not under his supervision will change a dimension here, a radius there, for this may ruin the effect he was striving for. He is not arbitrary, for he appreciates production problems almost as well as the client. But if changes are to be made, he wants to know about them, because other modifications may be necessary.

That is why good design costs money, and, incidentally, why it is worth it. For the designer is not only an artist. He must have common sense about things mechanical, even though he is not an engineer (and some are). He must be inventive; he must have a sound feeling for merchandising principles and practices, and he must constantly have his finger on the public pulse. In other words, he is a specialist in the creation of eye-appealing merchandise. And all merchandise must have that appeal to the eye if it is to sell successfully in today's competitive market.



But now for the other side of the medal. I have painted the industrial designer as a pretty clever chap. Sometimes he is. But, like every one else, he is human. Because he has done an outstanding job on one product does not mean that he can repeat his triumphs on every other one.

Some of the high-powered publicity that has been focused on industrial design has perhaps tinted the picture with a little too much rose. The designer is no wizard. He is not infallible. In some instances he may help to cure an ailing business, but he can't be doctor, nurse, insurance company and hospital all in one.

Eventually he will take his place in the industrial world as one cog in the machine. He is a specialist and should be given the same consideration as any other specialist, whether technical, legal, or administrative. But business can no longer overlook him, nor can it pick up his special services on any old street corner.

# A CLOUD NO BIGGER THAN A LADY'S WRIST

*Everybody cheers . . . . seventy-five per cent of all costume jewelry sales are cast-phenolics . . . . but there's a danger signal in the distance*

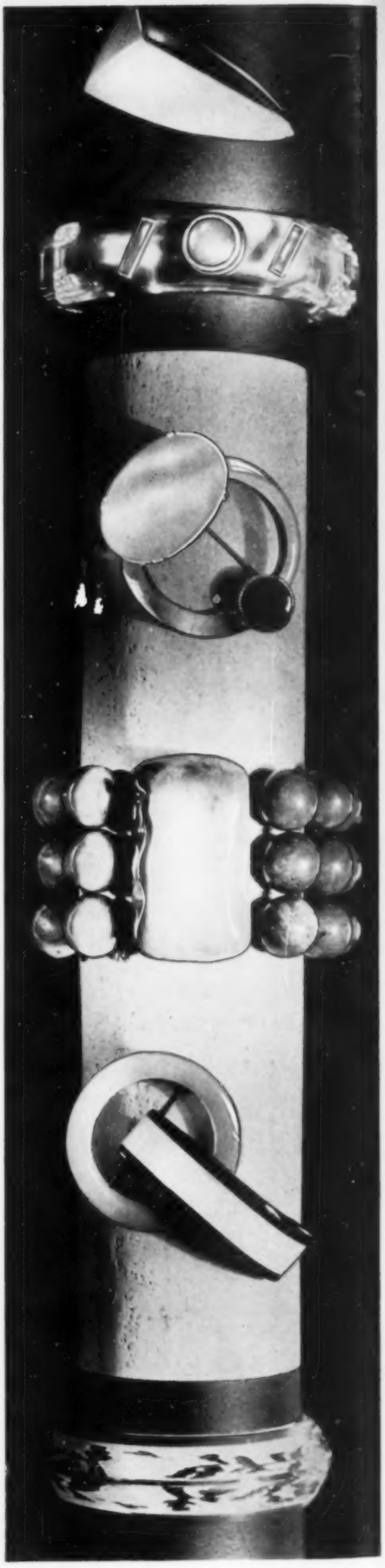
Altman's does fifty per cent of its costume jewelry volume in cast-phenolics. Saks Fifth Avenue averages over fifty per cent cast-phenolic sales. Fifty-seventh Street stores such as Miriam Haskell's estimate their sales at sixty, sixty-five, seventy per cent and better.

Cast-phenolics have seemingly captured the costume jewelry market. In fact, in four short years they have practically *created* a market that hitherto did not exist. For costume jewelry sales are today many times greater than before. Yet amid the general rejoicing, a small voice utters a cry of warning. "Look-out," it whispers, "Success—too complete success—is a dangerous thing in a style market."

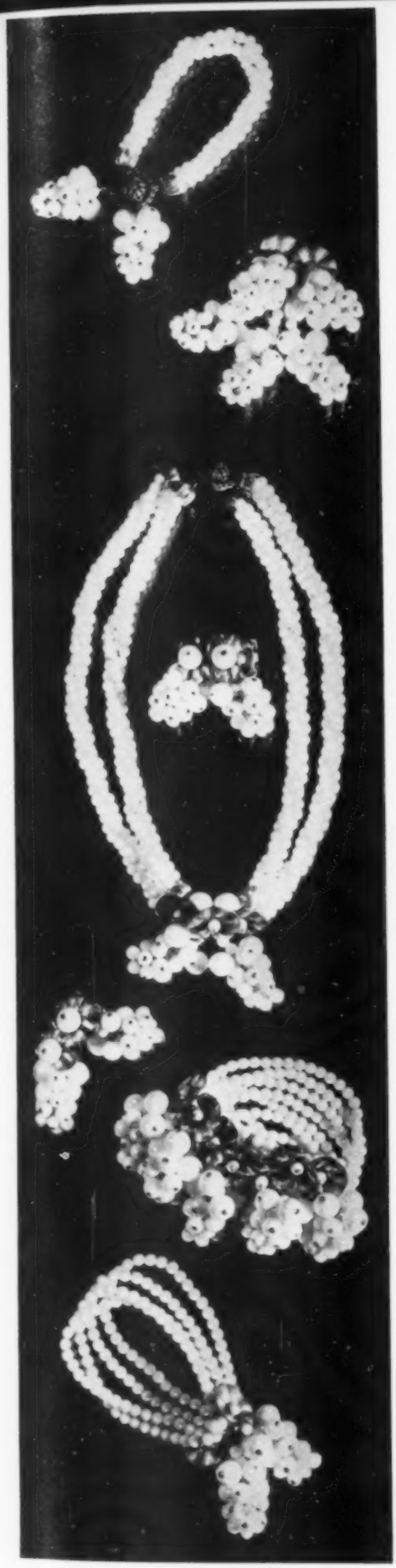
As yet, the voice is small. It doesn't predict trouble—it merely warns of the possibility. But because it comes from the throats of the important department-store buyers the voice should command attention. For no one is better equipped to feel the delicate, the fickle pulse of public reaction than are these buyers. Mind you—they want to sell composition jewelry. They recognize the tremendous advantages which cast-phenolics hold over less subtle, less easily worked, less beautiful materials. They praise the progress which jewelry fabricators have effected to date.

Yet they warn that this progress must continue—at an accelerated pace—if synthetic materials are to maintain their hold on the market. In the very reasons for the present success of synthetic materials these buyers see the possibility of future disfavor.

Cast-phenolic earrings, bracelets, necklaces and rings are things of low intrinsic value. As compared with semi-precious stones and metals, they have an extremely low material cost and an equally low fabrication cost. They have made possi-



Left: Six "best sellers" from the Bonwit Teller spring and summer collection of costume jewelry. Right: Six items selected by Saks Fifth Avenue as outstanding successes of the season.



ble for the first time, the use of multiple sets of costume decorations. They have made possible the wearing of jewels as dress accessories by persons whose incomes are in the middle and even in the lower brackets.

Today, a woman may possess more jewelry than Cleopatra could boast of—yet its total cost need not have run over thirty dollars.

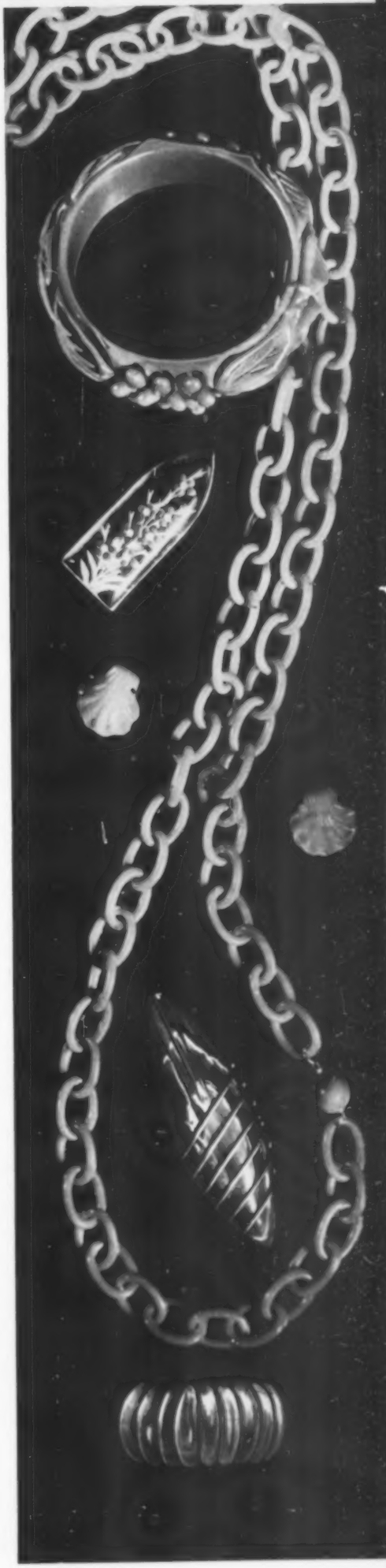
Cast-phenolics are quickly fabricated. And modern "high-fashion" demands speed. Markets appear, and disappear, within a few weeks. Timeliness carries a high premium.

Cast-phenolics likewise possess great adaptability to use, high decorative value, color and brilliance. All these are qualities which have played an important part in winning this market. All have combined to make cast-phenolics the ideal base material for apparel decorations.

Why then the red flares? Why then the warnings?

Because—as department-store buyers see the situation—these very qualities may yet destroy the vogue for cast-phenolics. Low material costs, low fabrication costs and high fabrication speeds are three factors that invite design piracy with its inevitable cheapening of quality and destruction of price structures. In the better grade stores buyers prefer to keep their shelves clear of stock which is likely to be duplicated or, worse, cheaply and poorly imitated within the span of a few days or weeks. Even in stores selling to the middle and lower class markets there is a general fear of handling goods so subject to quick low price duplication. Among consumers too there is a general unwillingness to purchase articles which may, within a few days, be "ford-ized." Here we have one of the greatest dangers standing in the way of the cast-phenolic vogue. There is another parallel danger which in the eyes of buyers may result in the decline of the demand for synthetic costume jewelry. This lies in the fact that just because such jewelry may be produced without a large investment it is easy for small manufacturers to market ill-planned and ill-conceived designs. And these designs bring disrepute not upon the individuals

*(Continued on page 76)*



Left: A seven-piece ensemble from Miriam Haskell featuring plastic beads and gold wires, leaves and clips. Right: Delicate engraving and tooling feature Altman's "best sellers."

# A HOSTESS LOOKS AT PLASTICS

By HELEN UFFORD

In the lively, colorful world of plastics, much has happened and is happening and will happen to delight the heart of the hostess. Spread before her eyes she beholds a vivid pageant of articles made of synthetic materials. Articles that combine beauty and function. Articles that add colorfulness and gayety to the décor of her informal tables, tables set indoors or on terraces or in gardens. Articles that add bright color and vast convenience to her kitchen. Items that lend ease and convenience to the making and informal serving of iced drinks. Items that give an added comfort and luxurious ease and charm to her picnic kits. Items that, because of their sturdiness, pack safely. Items that make her children happy. Items for her bathroom, for her dressing table, for her desk. Decorative items for many special uses in her home—for her radio, her telephone, for smoking and other accessories.

And the parade of these attractive things is constantly being augmented by items that add new colors, new shades, new designs, new uses, opening up a world of new possibilities.

For her table-settings of certain informal kinds, the hostess finds many standard articles: nine-inch plates, salad plates, bread and butter plates, iced tea tumblers, water tumblers, footed cocktail tumblers, footed sherbet tumblers, coasters, cups and saucers, fruit saucers, cereal dishes, platters, cream and sugar sets, salt and pepper sets, sets for condiments, vegetable dishes, serving trays, candlesticks. In these articles the hostess is offered, in the main, standard colors and standard shapes.

It was inevitable from the very nature of things, that the hostess' bridge table and synthetic articles would be "that way" about each other. Lovely colors find a happy home on bridge tables. Things "easy to get out" are welcomed. And violence in the playing is met by these practically unbreakable plates and tumblers! Coasters, in different shades, are packed in sets of four and eight. And a great deal of devoted attention—although still not enough—has been given to smoking accessories appropriate for bridge table convenience. And, as liaison items between the kitchen and the bridge table, we have the enormously popular little cutters that symbolically fashion cookies into the shapes of hearts, diamonds, spades, and clubs.

Children are very happy citizens in the world of items made of these colorful synthetic materials. And well they may be, for many charming things have been done for their delighted use—items gay and sanitary and shatter-proof. There are spoons and cups and handled mugs and plates and cereal dishes and bowls that His Highness may bang to his heart's content—and nothing will happen but a come-back for "more." There's a friendly turtle to hold the baby's cup and with compartments for his foods. And there are circus sand toys with humorous countenances and colorful personalities that cannot fail to charm any young visitor to the beach.

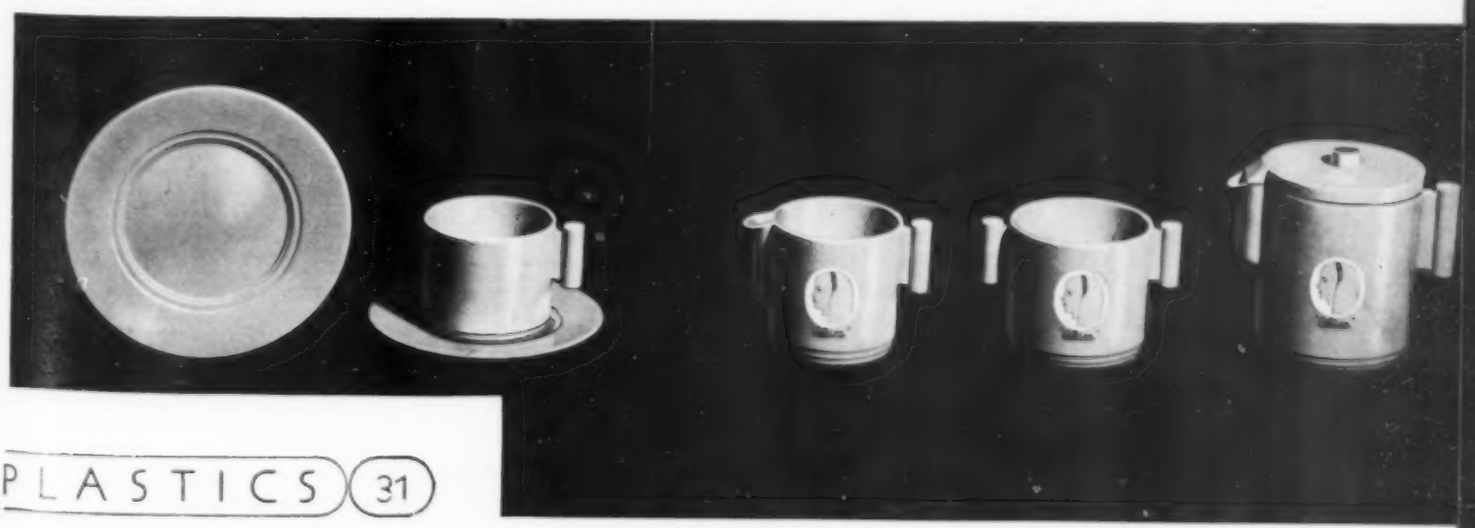
In the Richelain tea set for children The Richardson Company has done a superlative piece of designing and manufacturing from Plaskon. The "Alice in Wonderland" tea-set is its charming and unforgetable name. There are two kinds of sets, one the Little Housekeeper set; and one the Little Sister set. The Little Housekeeper is given four plates and four cups and saucers, while her Little Sister has to be content with two plates and two cups and saucers. Completing both sets are a tea-pot, a sugar bowl and a cream pitcher. The sets come in six glowing colors: green, yellow, cream, blue, orchid and red.

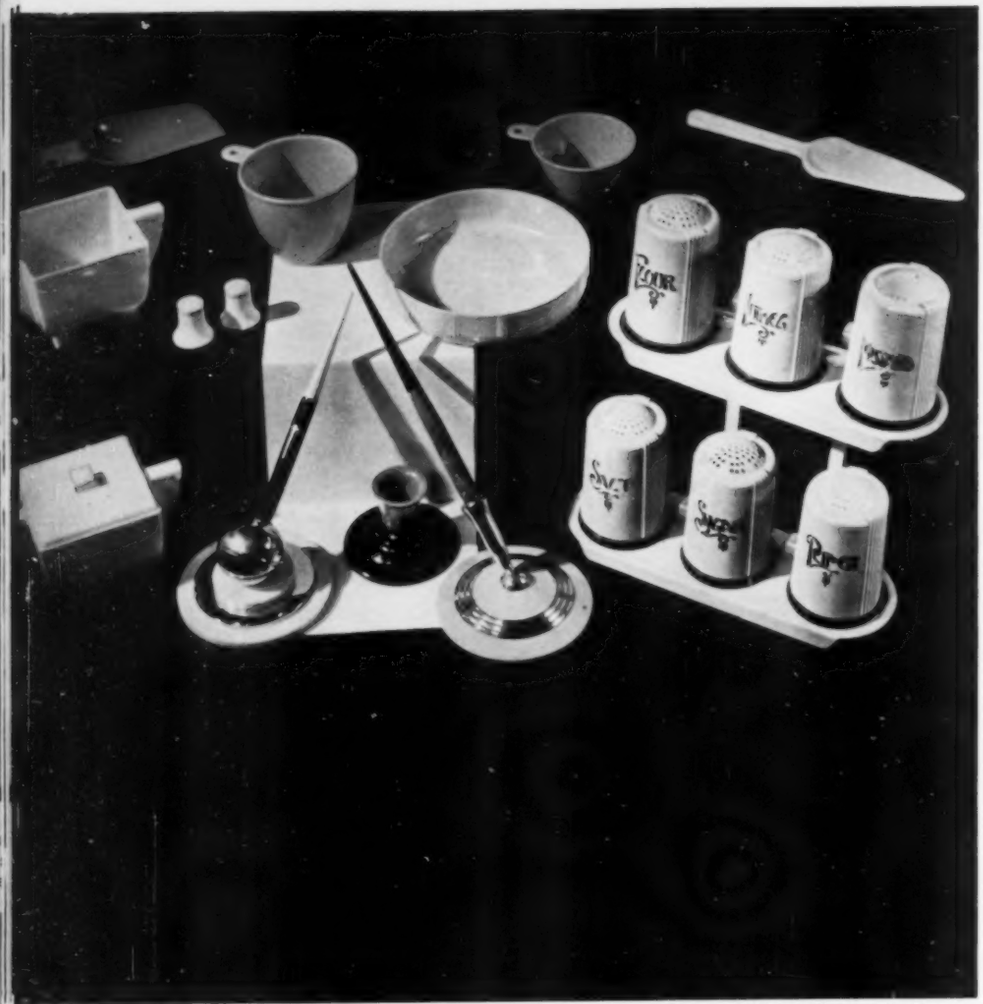
But, best feature of all, the designer apparently set himself the inspired task of making a design really worthy of his lovely material. It is obvious that the simple lines of modern design are especially appropriate for the designing of plastic materials. The items of this tea-set are an example of the adaptability of modern design. The handles are graceful, dignified, simple. The cups fit snugly and securely into the saucers by means of a design that indents three narrow planes on the saucers.

If more of this kind of worthy, dignified designing were done on similar items for an adult table-setting there would be more cause for hosannas!

No wonder is it that little girls, potential hostesses, dream of owning this set—and many of them found it on their Christmas trees last Christmas. To a little-girl-hostess her diminutive tea-table is her kingdom. She has the eternally feminine wish to have her table setting pretty. When she invites her little playmates to have "tea" with her, she doesn't want her tea-table to wear "hand-me-downs" of discarded dishes from the family cupboard. The dream of the little hostess is

Portrait reproduced on the opposite page is by courtesy of *Delineator*. The child's dishware, as shown in both illustrations, was molded by the Richardson Company






Courtesy of Toledo Synthetic Products, Inc.

to have her own tea-set, gay in color, of a simple diverting design—and in this "Alice in Wonderland" tea-set she achieves this ideal of charm and gayety. The dishes are, of course, practically unbreakable—"Play-Proof" is the wise word used by the company.

Devoted care and thought have been given, too, to the packaging of this popular tea-set. On the cover—paper of interesting texture disport Alice and her quaint and beloved companions from Lewis Carroll's immortal story. And inside—something to please Mother as well as her little daughter—is a set of rules for good table manners, written in the merry jingle form of the "Alice in Wonderland" lyrics.

A fine achievement, this, and I make so much of it because there has been too little done, I believe, of this thoughtful designing in the world of dishes for the adult table setting. No wonder we hear of so many mothers borrowing these charming cups and saucers and cream pitcher and sugar bowl to use in serving their own after-dinner coffee!

With more items made in lovely colors like these we find in Richelain and in the new pastel shades we find in Safety Ware, and with more "come hither" designs as we find in this "Alice in Wonderland" set, synthetic materials could, I believe, climb new heights and conquer new worlds in table accessories and settings.

Now when it comes to equipment for picnics and camping and all other kinds of "outings," synthetic articles do one of their best jobs—hard duty attractively accomplished. They have become a definite part of these great American pastimes. Today's compact luncheon kit, in appearance like a week-end case, is fitted with everything the picnicker needs to set the spread. To the inside lid are strapped knives and forks and spoons and plates, service for six or eight. Cups and tumblers, the foods in airtight containers, and the drinks in thermos bottles, fit into the body of the case. Volume sellers these, and deservedly so, for they develop all the modern improvements for our *al fresco* dining.

The kitchen is a happy hunting-ground for things made of these synthetic materials. There are racks to be attached to the wall and conveniently holding, sometimes on one shelf and sometimes on two shelves, condiments such as salt, pepper, sugar, flour, mustard, nutmeg, and so forth. There are all kinds and types of salt and pepper sets. All kinds of measuring gadgets: a set of measuring cups; one trick measuring cup, in which we may measure one or two or three or four cups of sugar or flour; a convenient group of measuring spoons, securely held together by a metal ring. Sugar and cream sets of various sizes, with an especially well-designed large one of Richelain. A mustard spoon, in light mustard color. A deep spoon to measure the "one tablespoon for each cup" of our coffee. Various kinds of flour scoops. An egg separator. Cutters for biscuits and for cakes. A convenient refrigerator dish, with clamps to hold the cover down, and with a handle that makes it adaptable for use as a lunch-box. One of the most practical uses for these synthetic materials is, I think, the handles of kitchen cutlery, and now we find these handles attached to all kinds of knives and forks and spoons. For her bathroom the hostess is offered tumblers and soap dishes—colorful and practical, and with practically no attempt to add design.

One of the most artistic, and certainly one of the most significant accomplishments in the field of synthetic materials has been the recent development by Beetleware (in Safety Ware) of beautiful pastel shades. Six of these delicate shades have already been developed: a delicate shade of green, a glowing light yellow, a soft peach, a lively orchid, azure blue and a lovely new shade called "dawn." Not many items have been made yet in these luminous new pastel shades, but enough to show the beauty and the possibility of the colors. Table accessories are especially effective in these shades, and so meticulous has the manufacturer been in developing the perfect shades of each color that a hostess would see at once what an artistic possibility she is given to combine the shades in, say, a table-setting for bridge on her terrace or in her garden. Four lovely shades that harmonize with one another—and they all *do* harmonize with one another—one for each bridge table, and the hostess would at once capture a thrilling new décor for her entertainment settings.

These items, besides being in these new pastels, are translucent. This added charm gives them a jewel-like quality

which makes them not only especially attractive for table settings, but which will, I am sure, make the interior decorator see vast possibilities in them for decorative items. Already we may see these lucid shades in small shades for side-lights and for small lamps. Radiant they are, for the light showing through brings out all the luminous quality of the material and its attractive colorings.

We might very profitably keep our eyes and our shrewd attention on what is being done in Europe with synthetic powders. We can at once eliminate what the English are doing, for they delight in the mottled effects that are, praise Heaven, not popular here, and most of their designs are, in the main, far from envy-compelling to our designers.

But many of the designs from France and Germany show the fine inspiration so often characteristic of the designs in general that come from these two countries. From France, for instance, come excellent examples of accomplishment in metallic inlays. The French *would* glorify a plate for baby by alluringly inlaying the always-fascinating word *Bebe* on it, designed in their flowing French script. What child wouldn't eat its porridge with happy eagerness to uncover such an engagingly written word! And how the French have glorified, too, in charmingly designed metallic inlays, the tops of all kinds of boxes and smoking accessories.

The Germans show us what they can do in a Salad Trio, in colors that are especially felicitous with salads. The salad bowl is footed, has a sloping, generous-sized, convenient-shaped bowl, and is of the bright yellow of dewy jonquils. The mixing spoon and fork, designed with a perfection of simplicity, have handle ends of rectangular pieces that serve the excellent function of holding the spoon and fork to the rim of the bowl. The spoon and fork are of a verdant green that is in key with salad-greens. This set is definitely one of the most attractive and useful things I've seen made in synthetic materials. It is consistently styled throughout with care and thought.

As a "sister act" to this salad bowl with its spoon and fork is another trio, smaller, and in the same colors, the bowl and fork and spoon for mixing the salad dressing. The combination is indeed very attractive and sensible, and gay.

The so-called "wing handle," for a sugar and cream set, is another triumph of German design and ingenuity. You may not like it—I do, for it adds an enlivening and stylized quality—winged, as its name implied—to a set that doesn't lend itself to many kinds of embellishments. And I understand that the process of cutting this design is a comparatively simple one. And the buffet table or cocktail table of any hostess would be enchanted to have the hors d'oeuvres tray, also designed in Germany, beautifully designed to hold three generous-sized glass dishes. Simple lines rim the containing spaces, and a simple design for the foot.

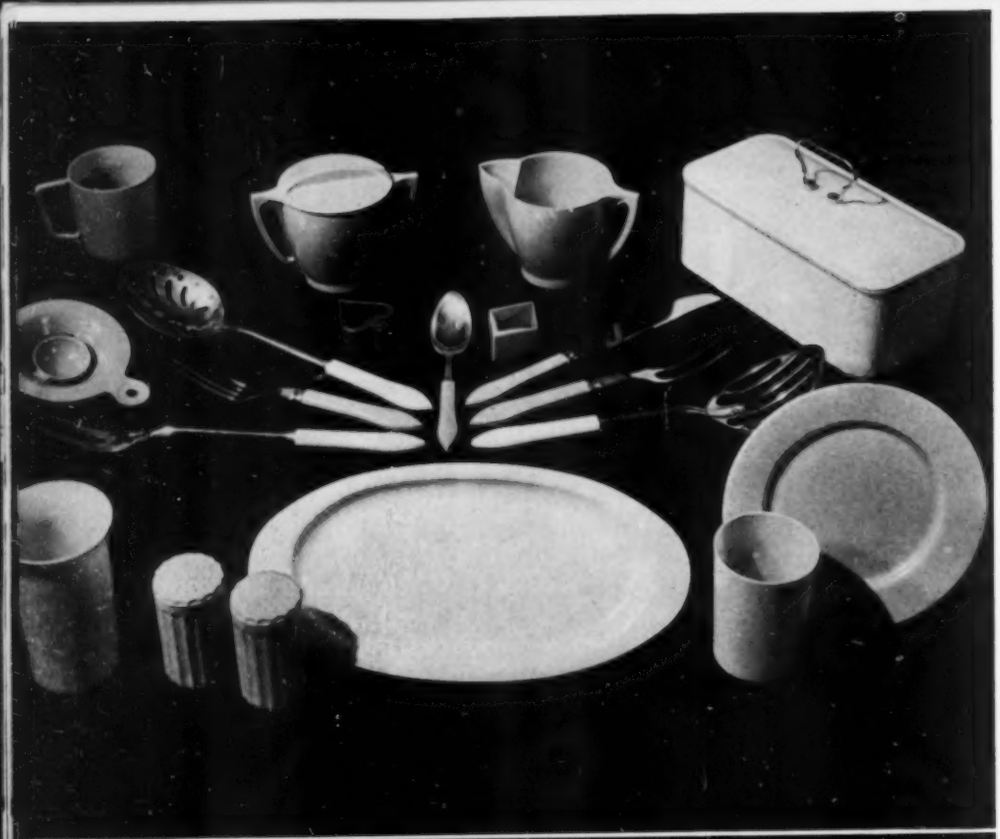
To ease the eye from the usual startness of such serving pieces as pie knives, cake knives and what-have-you, a few lines characteristic of excellent modern designing often welcomingly appear on these pieces in German designing.

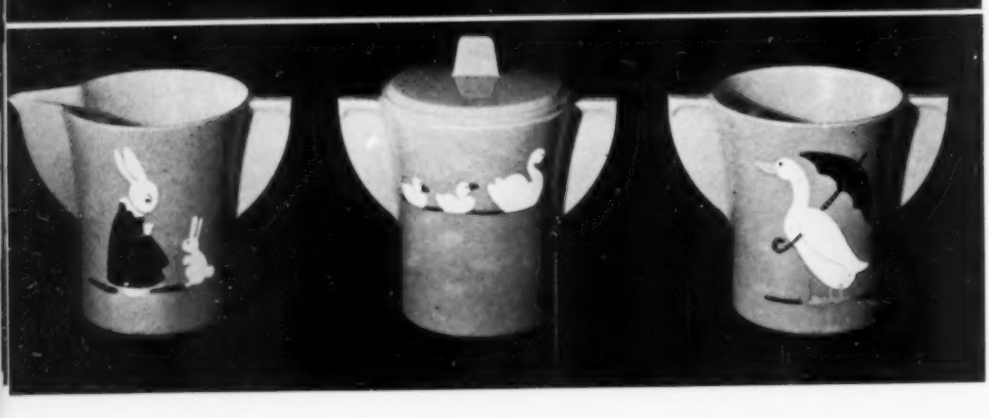
I suppose that the French wouldn't surrender their beloved silver base and top of their individual drip-coffee-maker, but apparently the Germans are willing to try something besides silver. In any event, they've made an individual drip-coffee container in synthetic material—and I welcome it, for this has always been one of my favorite gadgets, if one may refer to anything as steeped in tradition by such a modern term.

We don't use a brush and tray when we "crumb" our tables in this country, but they often do in Europe, and they must find delight in the compact and convenient way a set has been designed for them in a synthetic material. The brush handle is a semicircle of luminous black, the bristles of white. This brush fits into a perfectly designed red container that can be easily attached to a wall. This is such a grand idea, to my mind, that I should think that it could be incorporated for other kinds of brushes that we *do* find application for in this country.

As I look over the world of plastics, as far as the articles for the hostess' table are concerned, it seems to me that two definite pathways of progress could be made by way (1) of more inspired design, and (2) of more delicate colors. In these forward-looking days, when so much excellent designing has been done and is being done in fields similar to the field of

Courtesy of Reynolds Spring C





plastics, there must be many latent possibilities of designs that would glorify some of the most popular pieces in this synthetic world. Nothing could be duller than the "long drink tumbler" for instance, or the "water tumbler," or the "sherbet cup."

Modern design would seem to offer the most appropriate type of designing for articles made in these plastic materials—and certainly modern designers have had more difficult tasks assigned to them to style than those exemplified here.

If the manufacturers wish to keep their eagle eyes primarily on the world of premium-possibilities, of articles for children's use, for kitchen use, for picnic use, that's one thing, and certainly definitely understandable. But if they want to lure the hostess to buy really attractive items for her informal table-settings, the manufacturers aren't doing much that is interesting toward that goal. It seems to me that here could be a lifting quality in the design and in the contours that would have a new and refreshing eye-appeal for the hostess, a distinguished delicacy in the colors that would depart from the rather hard and uncompromising colors that hostesses are now offered too often in table accessories.

In the foregoing article, Miss Ufford has expressed, we feel, an opinion which is shared extensively by American women of taste and discrimination who are seeking the practical combined with the attractive in home furnishings. Kitchen, living room, dining room, bathroom and boudoir, all offer further opportunity for the utilization and display of articles and accessories made of plastics. The realization that such materials can express color and design and, at the same time, prove of utility value is, comparatively, new among those who represent a great potential market—the women of America. It is in the cultivation of this market—the supplying of sensible and pleasing designs in plastics—that there exists a tremendous opportunity for the manufacturer—Editor.

Above: A group of dishes and utensils supplied through the courtesy of Synthetics Plastics Company, Inc. The group below, also of Beetleware, is of foreign make. The bottom group shows one of the popular Richelain tea-sets which is molded of Plaskon.

# WITH PARTICULAR REFERENCE TO LAMINATED SHEETS

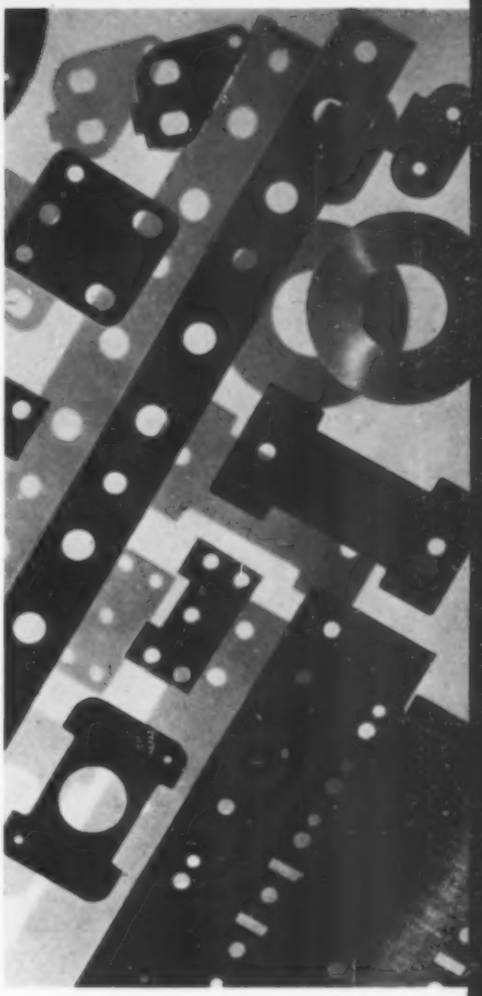
*BY N. S. STODDARD*

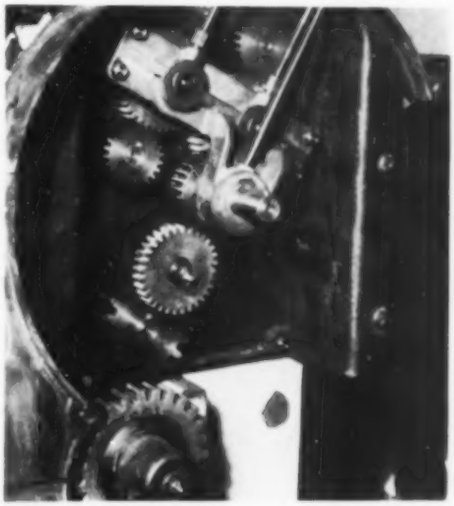
There are many manufacturers and engineers in industry today who still consider plastics as brittle and easily broken materials. This impression is a hang-over from the early days when the first plastic compounds were quite fragile and were applied only to products as insulation and for decorativeness, requiring no mechanical properties.

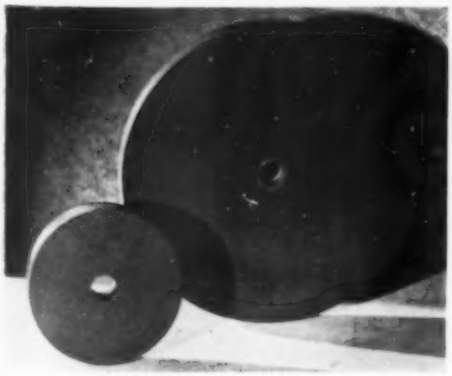
However, since the advent of synthetic resins into the commercial field in 1909, plastic products have been so widely applied that they now rank with metal, wood, and stone as one of the principal materials of construction. They possess such a remarkable assortment of properties, both mechanical and electrical, that they cannot be considered a substitute for the older and more commonly known materials, but must be regarded as a distinct group replacing and supplementing the older established materials.

This rapid growth of plastic products is attributed to the fact that new grades of material, which offer unique combinations of properties, are continuously being developed. Predominant among the advantages which give plastic products their broad applications are:

1. Simplification and improvement of apparatus design by using plastic products as both a structural and an insulating material.
2. Availability of colors and surface designs, permitting distinctive and decorative designs not readily obtainable with metals.
3. Elimination of the necessity for surface treatment, such as plating, polishing, painting, varnishing, enameling, etc.
4. Freedom from rusting or tarnishing.
5. Resistance to weather, water, oils, solvents, salt air, washing soaps, cleaning fluids, most acids, etc.
6. Low heat-conduction, which renders the products comfortable to the touch.
7. High ratio of strength to weight.
8. Resilience to absorb mechanical shocks and strains.
9. Low density, as compared to other structural materials.
10. Versatility of form.







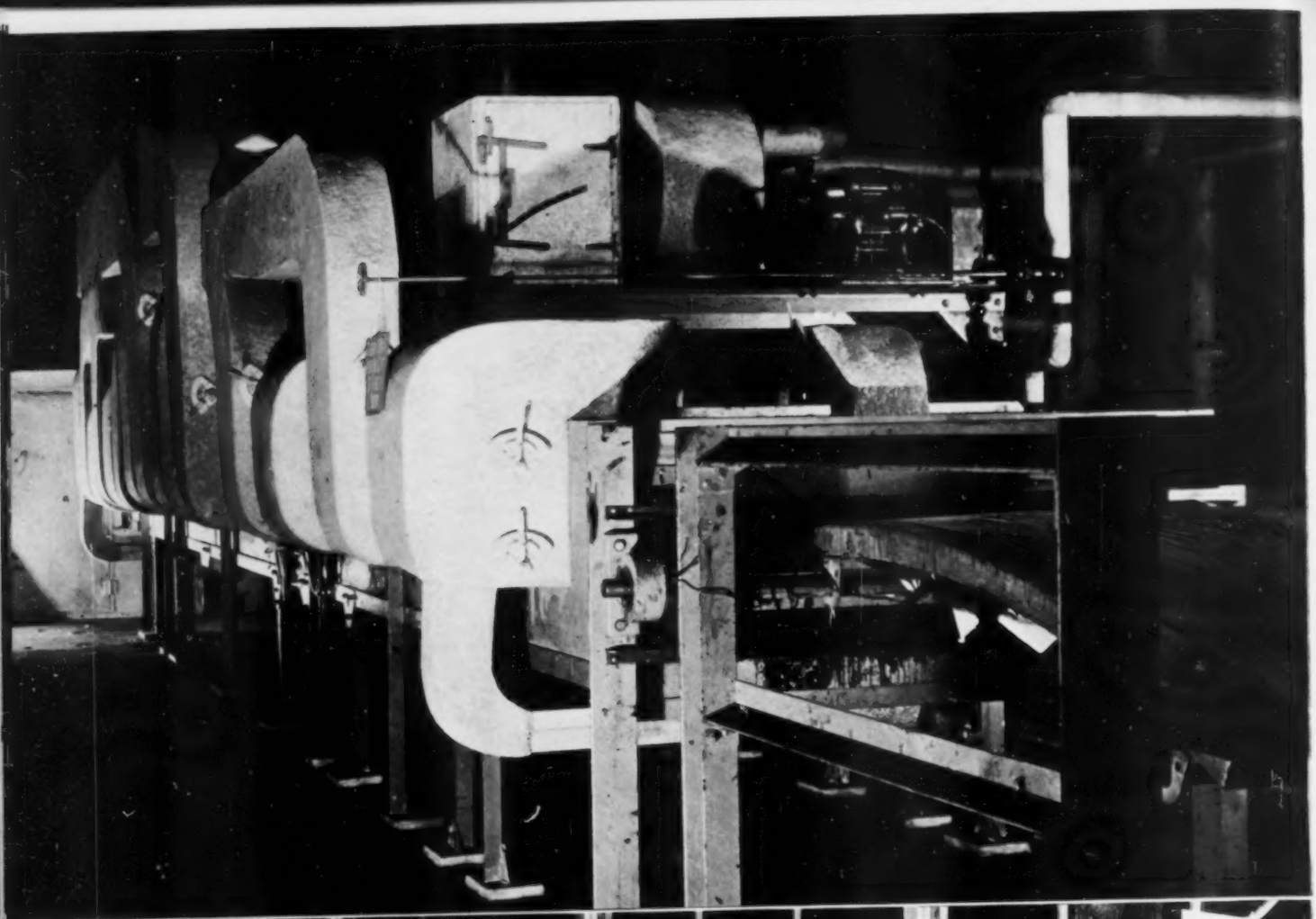
*Left;* Laminated pump-valve discs are fabricated from sheet stock and offer such properties as low moisture absorption, high impact strength, and resistance to high temperatures, wear and corrosion.

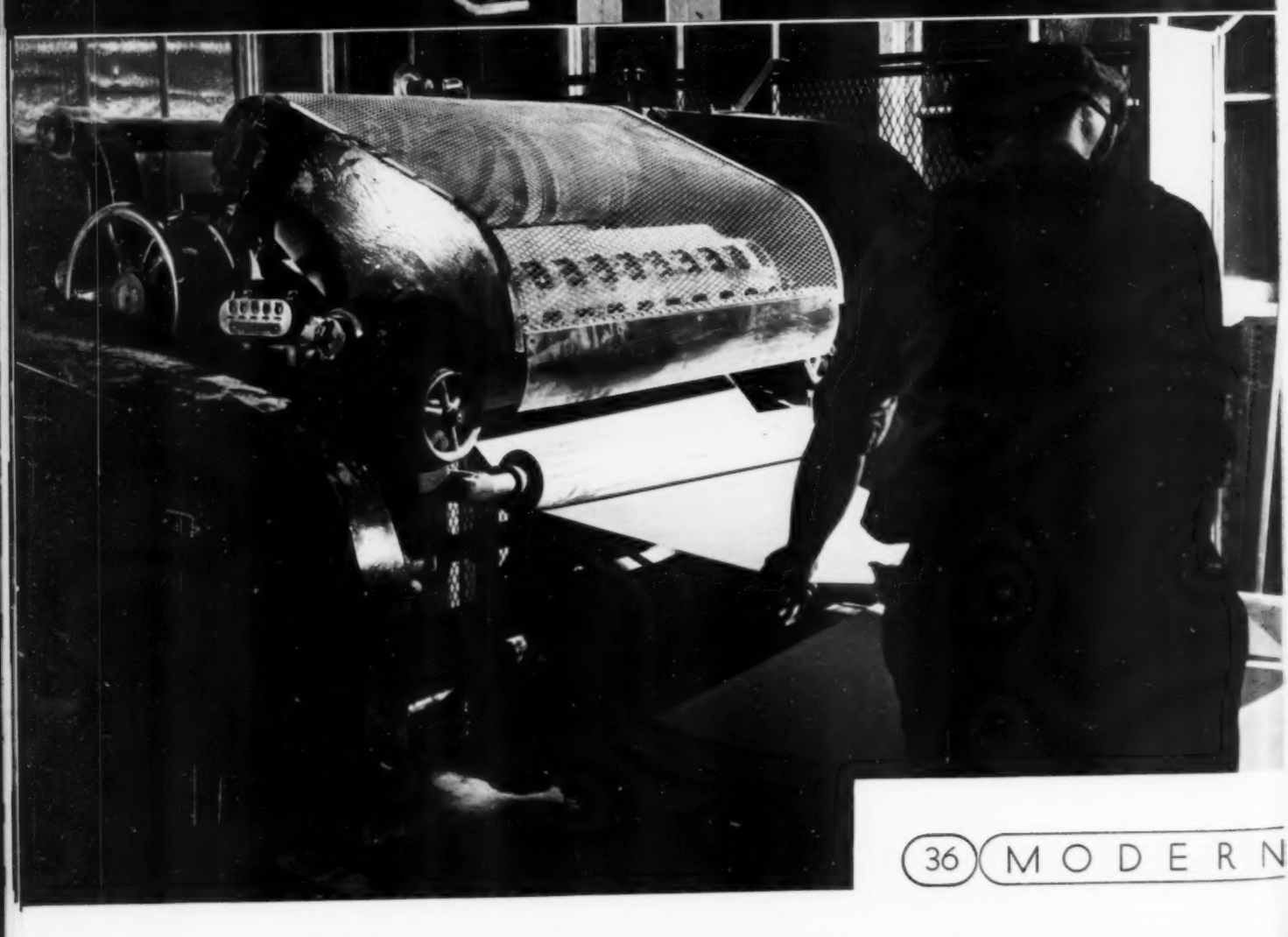
*Above;* Four laminated industrial gears are used on this adjustable drum loaf molder for its quietness and long life.

*Right, above;* Fabricated parts, as utilized for electrical and radio applications, punched from laminated sheet stock.

A large number of grades and compounds of these materials with different types of fillers and binders have been perfected to give combinations of the above characteristics in almost any proportion. Certain grades excel in mechanical strength and resilience; others have outstanding electrical properties. Some are more inert to the action of high temperatures and the electric arc while others resist water absorption and the action of most chemicals. Some are susceptible to molding into intricate shapes, while others are more readily machined to the desired form.

Great in number are the different types of materials which are classed as plastics, but among the most important of these are the phenolic laminated materials. Their ability to withstand shocks and stresses imposed upon them as important structural and mechanical members is rapidly increasing their use in the industrial fields.

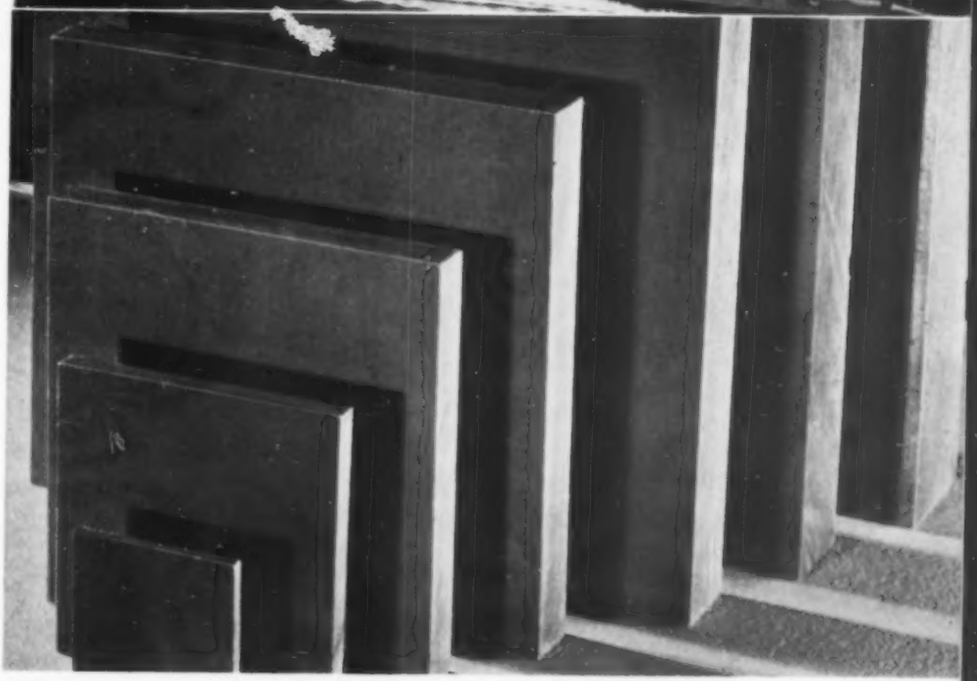




Little did we think, a few years ago, that these laminated plastics would be replacing metals and other materials for such applications as rayon spinning pots, loom pickers, pump valve discs, doctor blades, motor pinions, roll-neck bearings in the steel mills and textile carbonizer rolls, or for such applications as industrial truck wheels, golf club heads, wall paneling, and table tops.

The phenolic laminated materials are most commonly produced in the form of sheets, rods, and tubes. However, as in the case of the rayon spinning pot, they can be readily manufactured into special forms. It would be impossible to intelligently describe these four forms of laminated material in one article and do them justice because of the many grades and operations involved. Therefore, let us discuss in detail one of them, laminated sheets, with the expectations of dwelling as minutely on the other three in posterior issues of this magazine.

Laminated sheets usually consist of two raw materials: paper or fabric as a base



*Left, above;* Seventy-five feet long, twelve feet high —it is this type of treating machine in which the first and one of the most important steps is undertaken in the manufacture of plastic laminated materials.

*Left;* An ordinary type of cutting machine is used to cut the rolls of impregnated paper into lengths from thirty-six inches up to seventy-two inches.

*Right, above;* Two men weigh the treated sheets and stack them evenly, one upon the other, between the press-pans.

*Right, middle;* Not a monstrous giant of Oz but a fifteen-hundred-ton laminating press which heats and cures the laminations for fifteen finished sheets at one time.

*Right, below;* The finished product—widely diversified, industrial uses demand it available in any size up to 48 in. x 110 in. and in any thickness from 1/32 in. up to 5 in.

and a synthetic resin of the phenolic type as the binding agent. The decision whether paper or fabric will be used as the base for a certain sheet depends entirely upon the application for which the sheet is intended. For example, if the sheet is to be a table top, paper will be used because a more highly polished and smoother surface can be secured. On the other hand, if it is for pump valves, fabric would be more suitable to impart the necessary mechanical strength and secure a sheet with a low moisture absorption and resistance to corrosion.

However, the use of paper or fabric does not determine entirely the characteristics of the finished sheet. The resin also plays an important part, in that special handling of it varies the degree of resilience and durability of the finished sheet.

The manufacture of laminated sheets begins with the impregnating of the rolls of paper or fabric with the phenolic resin in solution form.

Maximum care and the follow-through of the most minute details are necessary to assure uniform mechanical and electrical properties in each piece. It is apparent, therefore, that this first step of impregnating is by far the most important process. The paper or fabric enters the treating and drying machine at one end, is dried, then dipped into the phenolic resin varnish which is distributed throughout the material in a uniform deposit. The amount and character of the impregnation are regulated very precisely by variation of the viscosity, specific gravity and the character of the varnish. There are also mechanical controls in the impregnating machine which can be set to give a uniform light impregnation or a heavy coating on one side or the other of the fabric or paper.

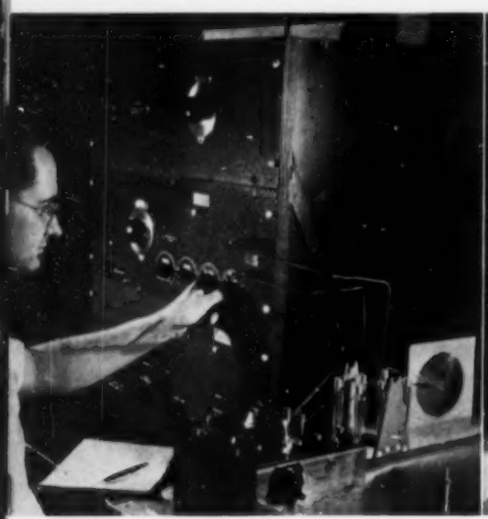
By a series of rolls and endless conveyors, the treated paper or fabric enters the dryer from the bath at a slow, continuous speed. Within the oven the temperature is exactly controlled, with zones of varying amounts of heat and air circulation to allow the alcohol solvent in the varnish to be removed at the proper rate.

As the impregnated material emerges from the oven, it passes over a cooling plate and is rolled up on reels, ready for the next operation of cutting into lengths.

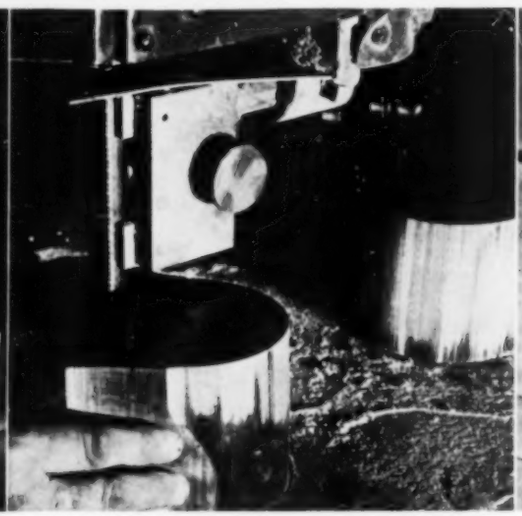
One of the ordinary types of cutting machines is used to cut the reels of treated paper or fabric into lengths, varying from thirty-six inches up to two hundred and fifty-six inches. The length depends entirely upon what the finished laminated sheet is to be used for. The standard length is usually seventy-two inches.

From the cutting room the lengths are conveyed to the next operation where they are carefully weighed and stacked to the proper number of laminations in order to give the desired thickness to the finished sheet. Each stack is sandwiched between two highly polished steel plates, called press pans, which impart their surface finish to the stack of laminations during the molding operation.

The performing of the molding operation takes place in a fifteen-hundred-ton hydraulic press having a series of steam-heated platens which have a carefully controlled temperature cycle. On to each

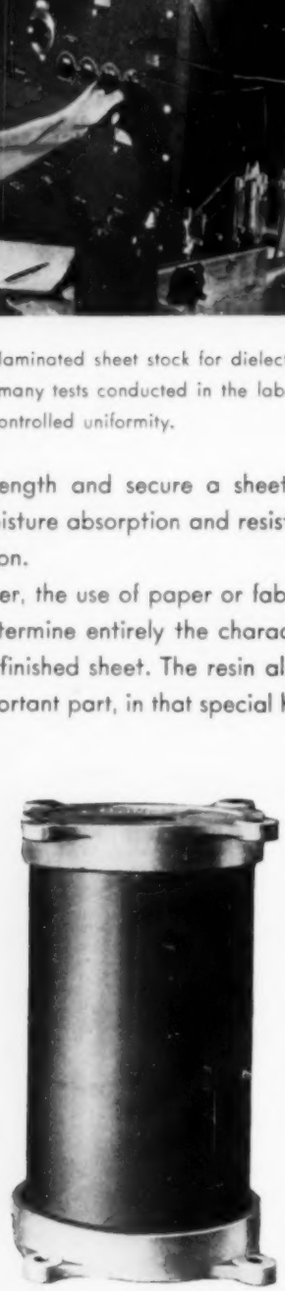


Testing laminated sheet stock for dielectric losses. One of many tests conducted in the laboratory to assure controlled uniformity.



The band-saw for sawing sheet stock travels at a speed of 8,400 ft. per minute, which actually means about 95 miles an hour.

A "set" saw, as shown here, is used for rough trimming; for smooth sawing, a "no set" with hollow ground faces does the job.



The manufacturers of these high-voltage capacitors find that phenolic laminated materials are ideally suited to be used as casings.

platen (usually fifteen) is slid a stack of laminations, grouped between the press pans. As soon as the press is loaded, it closes slowly until each stack is under a pressure of 1,000 to 2,000 lbs. per square inch. The combination of the applied pressure and heat fuses the impregnated resin and compels the laminations of each stack to be united together into a homogeneous sheet. With the continuation of the heat for a definite period, the sheet becomes permanently solidified by chemical change in the resin so that subsequent applications of heat will not soften it. The temperature pressure cycle is adjusted so that this reaction takes place completely. After complete curing, the press platens are cooled and the press opened for the removal of the finished laminated sheet.

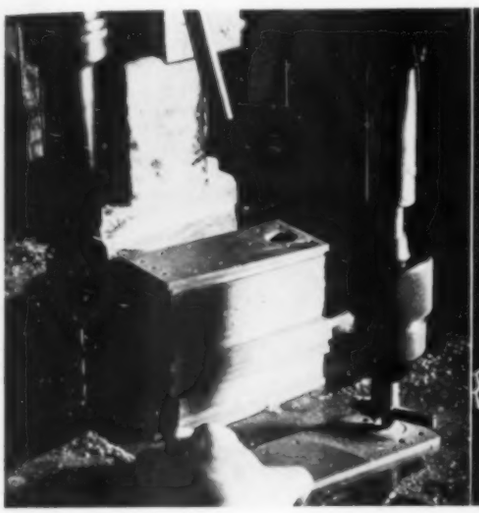
Samples of the finished sheets are taken at frequent intervals and subjected to a series of rigid tests as a final check on the manufacturing processes to assure uniform dependability. Two of the most important tests are for dielectric strength and dielectric hysteresis, both in the normal state and after the subjection to immersion in water. The nature of laminated materials permits accurate machining and easy fabrication of sheet stock. We deem it, therefore, worth your interest to briefly describe the different possible machining operations and the best method for the most satisfactory results. However, the larger manufacturers of laminated materials have their own fabricators who are primarily interested in offering all sorts of machined and fabricated parts. Because they specialize in this type of work they can, in most all cases, furnish a fabricated part to a customer at a price lower than if the customer attempted to do the fabricating himself.

SAWING: For sawing irregular or curved shapes from laminated sheets, the use of a band-saw having a pitch of 4 teeth per inch and traveling at 8,400 feet per minute is recommended. The "set" of the saw should be one-half saw thickness on each side so that the resulting saw kerf is twice the saw thickness.

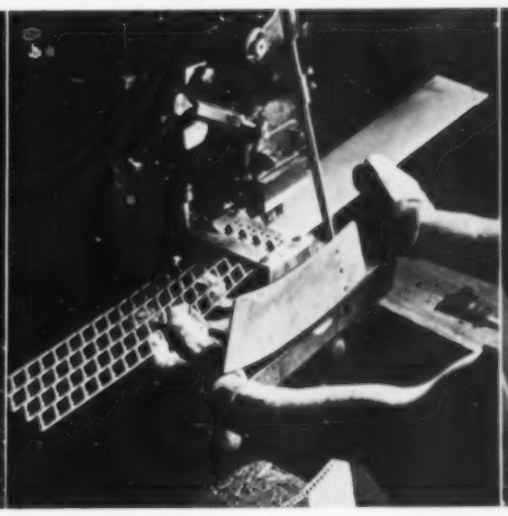
For straight cutting and trimming, use circular saws 12 in. in diameter, running at speeds of from 1,500 to 2,000 rpm. For rough trimming, use a $\frac{1}{8}$ in. saw with a "set" the same as that used on a wood saw. For smooth sawing, use a saw $\frac{1}{8}$ in. thick with hollow-ground faces and no "set". Thin material can be sawed at high speeds; thick material should be sawed at the lower speeds, in proportion to the thickness.

DRILLING: When drilling laminated materials, the fundamental principles is to keep the drill clear of chips and running cool. Best results are obtained with a twist drill having a long lead with the lips ground thin and with little rake. Some users grind the drill slightly off-center so that there is less tendency to bind in the hole. However, this practice is not recommended, because of the difficulty in holding the drill holes to the required size.

TURNING: For turning laminated materials, use the highest speed which the machine will handle, up to about 1,500 feet per minute. The turning tools shou'd be ground with very little top rake and considerable end clearance. For turning very smooth finishes, the radius of the tool nose should be as much as 7/32 in. or more. A



Laminated materials are readily adapted to drilling and fly-cutting as they are performed in standard shop practice.



Similarly, laminated materials may be punched by machine from strips—in any shape, size, and any thickness up to $\frac{1}{8}$ in. thick.

This illustration shows the manner in which the sheets are trimmed to the required size upon removal from the press.

Four pump blades are fabricated from laminated sheet material because it resists the corrosion action of gasoline.

tool which is too dull to turn laminated materials effectively will work well on steel.

PUNCHING: Laminated sheet stock can be punched readily in thicknesses up to 1/8 in. and, in some cases, to greater thicknesses. For punching thick pieces, it is desirable to use a shaving die, which gives much cleaner edges than a simple die.

Some grades can be punched satisfactorily cold, but it is recommended that all the material be heated somewhat before punching. This is usually done by laying the strips on a steam plate for a short while before punching. This preheating reduces the brittleness of the material and allows much cleaner punching.

In designing punched parts, it is very desirable to leave an amount equal to, or greater than, the thickness of the material between the edge of the holes and the edge of the punch.

TAPPING AND THREADING: The tapping and threading of laminated materials should be done with tools ground to very little rake and considerable clearance. In order to avoid binding, the drills for tapping holes should be slightly larger than those used in metal. It is desirable to use some lubricant, either light oil or turpentine, with the tapping or threading tool. This is the only machining operation on which it is desirable to use a lubricant.

PLANING: In planing, a high speed should be used—as high as possible with ordinary planing machines. For the roughing cut, a heavy feed should be used, but, for best results in finishing, the feed should be very fine. Tools must be kept keen. A facing of

## Properties of

Courtesy of

| N.E.M.A. Classification | Base Material | Colors | Finishes | Predominant Characteristics |
|---|---|---|---|---|
| X | Paper | Natural tan, black; also black surface, natural core | High polish, satin | High mechanical strength – good machining qualities–can be satisfactorily punched while hot |
| P | Paper | Natural tan, black; also black surface, natural core | High polish, satin | Excellent cold-punching and shearing qualities, consistent with fair mechanical and electrical properties |
| XX | Paper | Natural tan, black | High polish, satin | High insulating value, good machining and mechanical qualities |
| XXX | Paper | Natural tan, black | Satin | Low dielectric losses and low power-factor under high-humidity conditions |
| XX | Paper | Natural tan | Ground | High insulating value. Tube form only |
| A | Paper (Asbestos) | Natural tan, black | Satin | Unusually high heat resistance |
| AA | Fabric (Asbestos) | Natural tan, black | Satin | High heat resistance – mechanical strength–low moisture absorption |
| D | Paper | Red, green, etc.; also marble, mahogany walnut, and others to order | High polish, satin, dull | Decorative |
| LE | Fabric (Fine-weave) | Natural tan, black | High polish, satin | Good electrical and machining qualities |
| LE | Fabric (Fine-weave) | Natural tan | High polish, satin | Good electrical and machining qualities, plus low water absorption |
| CE | Fabric (Medium-weave) | Natural tan, black | High polish, satin | High mechanical strength with good machining and electrical properties |
| CE | Fabric (Medium-weave) | Natural tan | High polish, satin | High mechanical strength with good machining and electrical properties, plus low water absorption |
| L | Fabric (Fine-weave) | Natural tan | Satin | Tough, resilient, high mechanical strength and good machining qualities |
| C | Fabric (Heavy-weave) | Natural tan | Satin | Excellent wearing qualities–greatest possible resistance to impact loads |
| L | Fabric (Fine-weave) graphite-impregnated | Black | Satin | High mechanical strength, low water absorption–low coefficient of friction when lubricated |

Laminated roll-neck bearings for steel mills replace metal bearings at a tremendous saving in production costs.

Carboloy or some similar material will prolong the life of the tool and minimize grinding.

MILLING: When milling laminated materials with standard milling cutters, best results are obtained by running with a fine feed, and at as high a cutting speed as possible without burning the cutter—usually the maximum speed. If necessary, a deep cut may be taken with excellent results. A cutter with spiral flutes is preferable to one with straight flutes.

SHEARING: Material up to and including 1/8 in. in thickness can be sheared, except in cases where a very smooth finish is found to be desirable.

The shears must be kept sharp, and the

# Phenolic Laminated Materials

Plastics Dept. General Electric Company

| General Uses | Water Absorption at 30° C. | | Compressive Strength | | Flexural Strength (Modulus of Rupture) | Tensile Strength (Lb. per Sq. In.) | Dielectric Strength (Short time) 1/16" Thick at 25° C. Volts per Mil | Power-Factor at 1000 Kc. and 25° C. | | Dielectric Cons at 1000 Kc. at 21° C. | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Size of Sample in In. | After 24 Hr. (Per Cent) | Flatwise (Lb. per Sq. In.) | Edgewise (Lb. per Sq. In.) | | | | As Received | After 24 Hr. in Water | As Received | Afte Hr. Wa |
| | 1 x 3 x 1/16 | 4.0 | 31,000 | ..... | 21,000 | 12,500 | 700 | 0.05 | 0.075 | 5.5 | 6. |
| These four grades have been developed primarily for insulation in the radio, electrical, and electronic fields. They offer insulating qualities in different values up to the most exacting requirements. Grade selection depends on the electrical and mechanical strength required by the application | 1 x 3 x 1/16 | 4.0 | 23,500 | ..... | 15,000 | 8,000 | 600 | 0.06 | 0.09 | 5.5 | 6. |
| | 1 x 3 x 1/16 | 1.3 | 35,000 | ..... | 16,000 | 8,000 | 700 | 0.045 | 0.060 | 5.5 | 6. |
| | 1 x 3 x 1/16 | 1.0 | 35,000 | ..... | 15,000 | 7,000 | 650 | 0.035 | 0.045 | 5.0 | 6. |
| Any insulating purpose | 2 x 2 x ½ | 2.0 | | | | | 250 (½" thick) | 0.007 (at 1 ks.) | | | |
| General insulation and mechanical uses where heat resistance is of primary importance | 1 x 3 x 1/16 | 0.5 | 25,000 | ..... | 15,000 | 8,000 | 150 | ..... | ..... | ..... | ... |
| Similar to Grade 115, but offering greater mechanical strength—used for valve discs in contact with steam, etc. | 1 x 3 x ¼ | 0.7 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... |
| Wall panelings, table tops, desk tops, and general decorative uses | 1 x 3 x 1/16 | 1.3 | 35,000 | ..... | 16,000 | 8,000 | ..... | ..... | ..... | ..... | ... |
| Replaces other grades of Textolite for electrical and radio insulation when greater toughness and resilience are also desired | 1 x 3 x ¼ | 1.2 | 37,000 | 25,000 | 19,000 | 9,000 | 500 | 0.045 | 0.065 | 5.0 | 6. |
| Where exact dimensions must be maintained on machined parts and remain unchanged under temperature variations, and where resistance to water absorption is important, such as sleeve bearings in deep-well pumps and for gasoline-pump vanes, etc. | 1 x 3 x ¼ | .50 | 37,000 | 25,000 | 19,000 | 9,000 | 500 | 0.045 | 0.065 | 5.0 | 6. |
| General mechanical uses | 1 x 3 x ⅛ | 1.25 | 36,000 | 25,000 | 19,000 | 9,500 | 425 | 0.055 | 0.10 | 5.5 | 6. |
| Similar to Grade 113, particularly where it must remain unaffected by water absorption | 1 x 3 x ¼ | 0.75 | 36,000 | 25,000 | 19,000 | 9,500 | 425 | 0.055 | 0.10 | 5.5 | 6. |
| Fine-pitch gears, intricate punchings, and for mechanical uses | 1 x 3 x 1/16 | 2.0 | 35,000 | 24,000 | 20,000 | 10,000 | 150 | 0.010 | ..... | 7.0 | ... |
| For nonmetallic industrial gears and for mechanical uses where unusual toughness and a high ratio of strength to weight are required | 1 x 3 x ⅛ | 1.7 | 38,000 | 26,000 | 20,000 | 10,000 | 150 | 0.010 | ..... | 7.0 | ... |
| Water-lubricated bearings | 1 x 3 x ¼ | 1.0 | 37,000 | 25,000 | 19,000 | 9,000 | ..... | ..... | ..... | ..... | ... |

cutters adjusted so that there is no clearance; otherwise, thin stock has a tendency to "creep" as the shear progresses across the sheet. Stock should be heated before shearing.

SURFACE FINISHING: When possible, the natural finishes of the sheets should be used—high polish, satin, etc. If necessary to finish a machined surface, this may be done by rubbing with emery and then finishing with pumice and oil. Do not use emery or carborundum in finishing materials for electric apparatus, as particles of emery may become embedded in the surface and affect the electrical properties.

The table of the properties of laminated materials gives a list of the standard grades of phenolic laminated sheets (this also includes grades of rods and tubes) as classified by the National Electrical Manufacturers Association and indicates the ph cal and electrical properties of each gr It should be emphasized that the pro ties of the various grades as set forth in table represent average values.

In addition to these N. E. M. A. gra special grades are available which h been developed for particular applicat that require a combination of prope not offered by the standard grades. new applications which require sp grades, still *(Continued on page*

# *Plaskon*

## MOLDED COLOR

Plaskon, though but lately come to the field of molding compounds, has made possible values of color and durability previously claimed but actually non-existent.

It is unnecessary, today, to characterize these special values. It is unnecessary for Plaskon to claim a superior power for building sales and winning new markets. It is unnecessary to list the wide range of products upon which Plaskon is being applied. Plaskon values are proved values that have made history in this field.

Plaskon invites a comparison with other plastics from all who are not yet familiar with these qualities. And its manufacturers intend to hold to the policies adopted when the company was formed and which have characterized all Plaskon operations.

Any list of Plaskon applications gives conclusive evidence of its versatility but Plaskon will never be presented as a material suited to universal use; it will be

recommended only for those applications where Plaskon's special values make it peculiarly suitable. To interested persons the manufacturers will gladly mail, upon request, a full-colored brochure which has just been prepared, visualizing in part the broad scope of Plaskon adaptability.

The manufacturers recognize that no user receives the full value of their product until an expert molding job has been done. They are jealous of all that Plaskon has to offer. They are therefore prepared to recommend molders who firmly adhere to the policy of doing a job in only one way—the way that has been proved to produce articles of the highest quality. To assist molders in attaining this end, Plaskon has developed rigid specifications for certain types of work.

We invite inquiry for additional information.

TOLEDO SYNTHETIC PRODUCTS · INC · TOLEDO · OHIO

# LIGHTING THE SMART WAY

## A MANUFACTURING AND PACKAGE PROBLEM IS SOLVED SUCCESSFULLY THROUGH THE USE OF A MOLDED PLASTIC

By CARL J. BEGEMANN

Cigarette lighters were practically a dead issue during the 1932 Christmas Season. It seemed that smokers considered book matches the best thing after all. However, new life and interest was injected into the lighter business when the first compact automatic flameless cigarette lighter was announced under the name of "Lektrolite" during summer of 1933. More lighters of all types were sold during the Fall and Winter of that year than in the past three years together.

Like magic, the Lektrolite lights up a cigarette without spark or flame. It has no moving parts whatever, just puff a cigarette against its cold lighting tip and you have a perfect light. In addition to its simplicity of operation, Lektrolite has one quality above all others—it is 100 per cent windproof.

Lektrolites sell in a price range beginning at $5. They are housed in a nickel shell and packaged in attractive gift boxes. Naturally, the price range confined the sale of this matchless lighter to the gift and class market. By making the package part of the product and using less expensive materials, the convenience and luxury of flameless lighting was made available to the greater mass of smokers in the form of the Glolite, at $2.50 and the Glolite Midget, at $1.00. These lighters retained all the mechanical and service features of the de luxe Lektrolite.

The process of bringing flameless lighting into the popular priced range was not without its difficulties. Experiments indicated that this could be most efficiently and attractively accomplished by the use of plastic. The type of plastic which would best meet our manufacturing requirements, and, at the same time, have the eye appeal of color and finish to take the place of a separate package was not easy to find.

It required further experimentation before the selection of plastic, which would comply with the specific requirements, could be made. In this instance there were two important considerations that had to be taken into account—the chosen plastic had to be able to overcome those. Some materials were too porous and impractical for our purpose. A methanol alcohol compound is used in refilling flameless lighters. Alcohol will penetrate substances usually waterproof. In addition, it seemed that the Lektrolite fluid released the odors of the formaldehyde inherent in certain compounds—an objectionable feature.

Plaskon, the material finally selected, not only met all our manufacturing requirements regarding odor, porosity and ruggedness, but also provided a distinctive color range and glossy finish that sells Glolites on sight from counter cards. The soft pastels and deeper shades of the plastic housings in their lipstick style are attracting women smokers by the legion. Men, too, find the black and navy blue lighters, either in solid color or in combination with white, much to their liking. No larger than a shot-gun cartridge, Glolites or Glolite Midgets fit conveniently into any vest pocket. Smart Set, as shown in the accompanying illustration, is a boudoir set of six Glolites in six different colors. The woman of fashion can select from these whatever color best matches or contrasts with her ensemble of the moment. Smart Set is found in practically every dressing room in Hollywood, and the vogue is spreading rapidly.

By making the package part of the product and using Plaskon, flameless lighting has become the smartest and cleanest way of lighting cigarettes. The utilization of a plastic in the development of these lighters also indicates the extensive possibilities of such materials for other uses in which their properties are desirable if not essential.

In this instance it was not a question in which a substitution of materials was the important factor. The idea of flameless lighting was distinctive of itself. But it was recognized that color and finish, as provided by the plastic used, could play a large part in winning the consumer's acceptance of the product, that desirable contrasts could be obtained, and these would add to the buying motives already supplied by a unique and original device. Considering this in the light of other products, the progressive manufacturer can well ask the question, "Can a plastic solve my problem?"

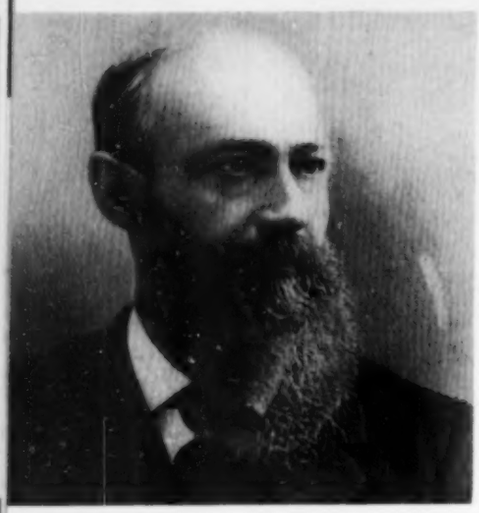
Molded plastics, in attractive colors and color combinations, supply the necessary requirements for adaptability and consumer appeal as a material for pocket lighters

The Smart Set includes six lighters, each in a different color so that Milady may choose the one which matches or contrasts with her costume—for a complete ensemble

# EASTMAN INTRODUCES A MOLDED CAMERA

Molded plastics have long been used in the manufacture of photographic equipment. The experience which such firms as Eastman Kodak have had in the development of synthetic materials for use in photographic films has for many years made such firms receptive to the possibilities of utilizing molded parts in the construction of cameras, projecting and developing equipment. Thus, we find individual molded parts (combined with metal, fabric, board and leather) in many of the finer cameras produced today. Likewise molded plastics, because of their non-reactive qualities have found wide use in the manufacture of dark room equipment—articles which must stand up through long periods of service under the action of comparatively strong chemicals. It has remained, however, for the last year to bring forth the complete molded camera. Within that time at least two manufacturers in this country have produced cameras of midget size in which all except the shutter and sighting parts have been made of synthetic plastics. A very large market has remained open to the plastics field—a market limited on the downside by the need for a "real" camera capable of taking customary size snapshots and limited, if at all, on the other side by the requirement that a reasonable price must be maintained if a sufficiently large volume is to be secured to justify mold costs.

The Eastman Kodak Company has now successfully placed upon the market a camera which meets all of these requirements. The new molded Eastman Brownie, designed by Walter Dorwin Teague, equals and betters the accomplishments of the long successful box-type Brownie camera, while providing many additional advantages arising directly from the qualities inherent in a molded job. The camera itself is less than one-half the size of the original box-type camera. A series of fiuted lines extends around top, front and bottom of the camera. Visible metal parts are *(Continued on page 64)*



## HYATT AND COLLAR

John Wesley Hyatt invented Celluloid in 1868 while seeking a substitute material for ivory billiard balls. Today, Celluloid boasts over 25,000 applications. Most famous—though never most important—was the Celluloid Collar. The Celluloid collar joke in its myriad variations supported a whole generation of vaudeville artists. A glance at the right will disclose the source not of the humor, but its companion the celebrated Celluloid cuff. Incidentally, you can—and many people still do—purchase Celluloid collars and cuffs. Principal users—waiters, ship stewards.

# CELLULOID—GRAND-DADDY OF 'EM ALL

*BY GEORGE H. BOEHMER*

The growth of the United States from a primeval stage to a dominant world power in the course of three hundred years has been rightfully called the Epic of America. As it was in the case of this new country with its immense hidden resources passing through three distinct phases of development—experimentation, exploitation and stability—so it has been with the basic industries of our country.

The plastics industry although sixty years of age is still in its period of exploitation, and not entirely through its experimental phase. To appraise the potentialities inherent in this industry one has but to examine its recent amazing expansion in the last two decades. It is stated that the total value of all plastics produced in the United States in 1914 amounted to fourteen and a half million dollars, and that at present the plastics industry has grown to produce annually in excess of two hundred twenty-five million dollars. These figures, although approximate, reveal the vigorous expansion of the industry since the World War. The plastics industry compared to others, such as steel, is still an infant, but an infant showing promise of becoming one of the foremost industries of our country.

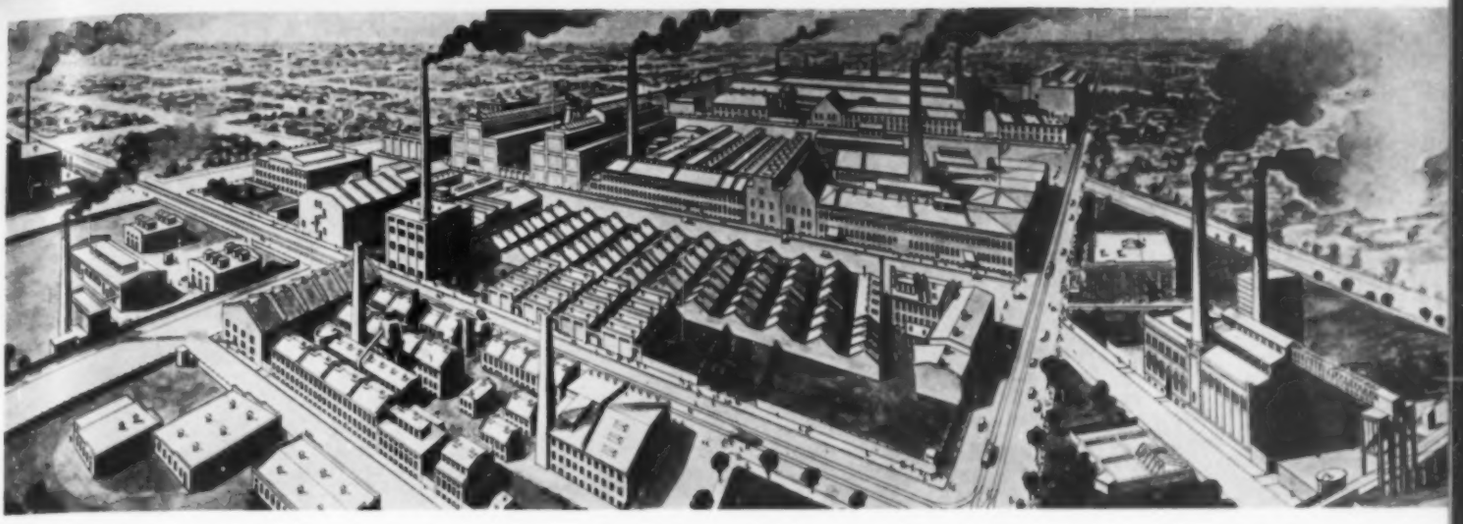
Daring feats are done by daring men. So it was a venturesome spirit that moved those early settlers to come to a new continent. Similarly, it was a daring spirit that urged John Wesley Hyatt, a printer by trade, to set out for the discovery of a substitute material for ivory billiard balls. The prize for a successful discovery was $10,000, offered by a prominent New York billiard firm.

It is not known whether Hyatt succeeded in obtaining his prize money, but his attempts to compress a mixture of paper fiber and shellac to a hard resilient sphere by the aid of heat and with coatings of dissolved pyroxylin made white with suitable pigments led to the eventful discovery of celluloid and the foundation of the present Celluloid Corporation in 1872. Therefore, in retrospect, it can be stated that the growth and development of Celluloid Corporation depicts the beginning and the growth of the entire plastics industry, for, sixty years ago this industry did not exist at all.

There is always a constant search for new materials which Nature does not provide or, because when found, they are too rare, expensive or not adaptable for industrial uses. It was realized as early as 1850 that Nature's gifts to the industrial arts were fast depleting. The elephant who once roamed the forest in gigantic herds was fast fading away before the hunter, and the great stores of ivory left in the earth by his long line of ancestry were almost exhausted. The tortoises were also being destroyed by men who coveted their wealth. Nature's provident stores of amber had been mined until they too were exhausted. Dentists were begging inventors to furnish them a substitute base for the then expensive rubber. The time was ripe for Celluloid, and John Wesley Hyatt by reason of his extraordinary ingenuity and mechanical skill offered to the world in 1868 the first plastic material, "Celluloid." This important incident in the comparatively short history of the plastics industry is mentioned to indicate the birth of an industry which out of laboratory test tubes created a range of new materials adaptable to an unlimited range of industrial uses.

The fact that cotton or cellulose when dipped into a bath of nitric acid and sulphuric acid became soluble in a mixture of ether and alcohol was well known to Hyatt and others before his time. When the solution so formed was evaporated it left a transparent film of nitrocellulose resembling a thin piece of isinglass. This film was the forerunner of Celluloid, and was commonly known as collodion used as a coating for wounds and for photographic plates.

Before passing this prenatal phase of Celluloid, it may be well to discuss the raw materials forming the basis out of which this compound was discovered. Cellulose is the prime raw material for Celluloid. It may be described as a marvelous framework supporting and enclosing the juices, resins, coloring matter and mineral substances which give earth's vegetation its character and variety. Cotton is considered one of the purest forms of cellulose. Sulphuric acid, one of the catalyzing agents



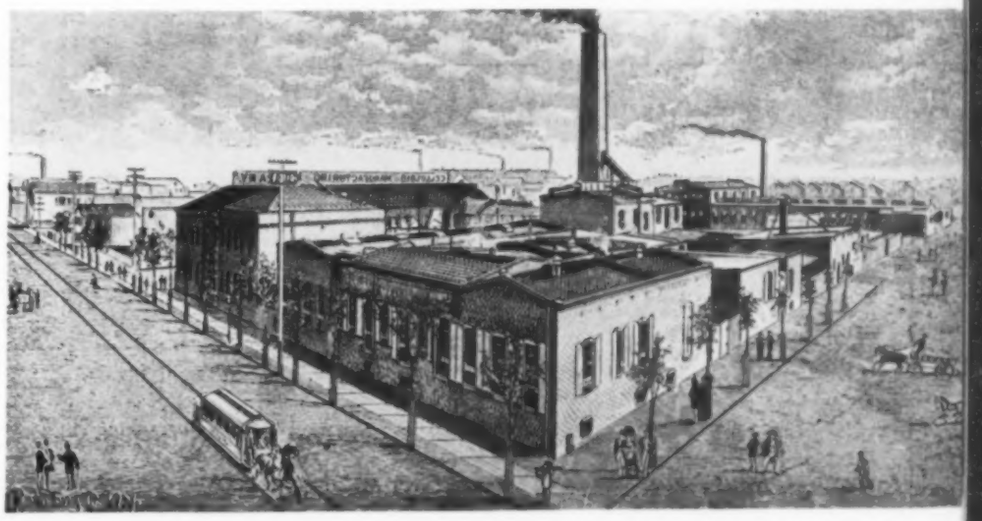
Celluloid's present plant houses 3,000 employees, covers 27 Newark acres, manufactures many other synthetic plastics in addition to parent, Celluloid.

of cotton, was known of old as oil of vitriol and was early made by distilling green vitriol. Nitric acid, called aquafortis by the old chemists, is a very active reagent causing a marked chemical change in cotton, referred to as nitration. Nitric acid was produced by heating nitre with sulphate salt. Both of these chemicals were known to the alchemists of old, who conducted their weird experiments within the shadows of the Egyptian pyramids. Today both of these important chemicals are produced through entirely modern means.

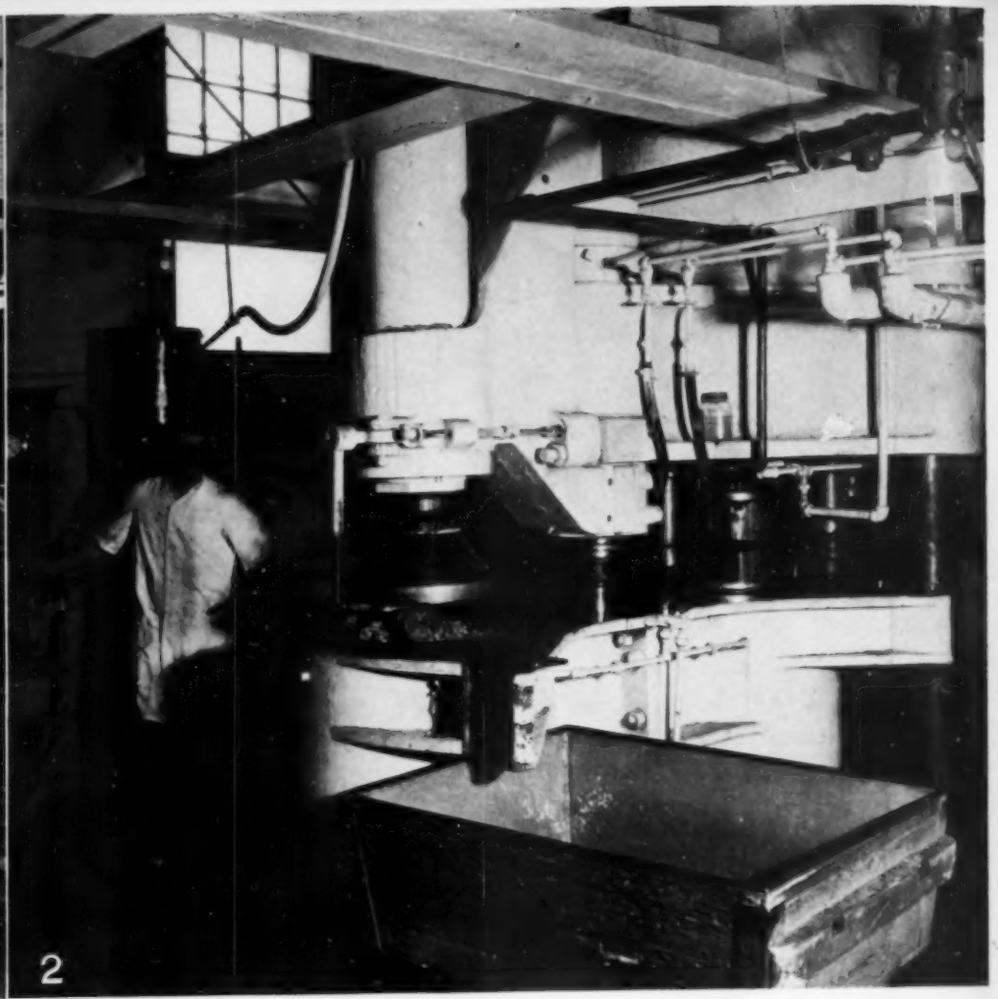
The soluble cotton used in the making of celluloid is made through the combined action of nitric and sulphuric acids. The resultant product is called nitrocellulose and dates its discovery to Dr. Schönbein of Switzerland in 1846. The tendency of nitric and sulphuric acid mixtures to form different kinds of nitrocelluloses explains the varied character of their reactions. Nitrocellulose with a high percentage of nitrogen, about 13 per cent, forms guncotton, highly explosive and so stubborn in the presence of solvents that it becomes insoluble and unfit for the manufacture of Celluloid, whereas nitrocellulose with a low percentage of nitrogen—about 10.5 to 11.5 per cent—is of an entirely different character and is noted for its plastic disposition. Its temper though hot is not of the explosive kind, and it is employed in the arts of peace. Nitrocellulose of low nitrogen content is known as pyroxylin and is an indispensable ingredient of Celluloid, but it alone does not make Celluloid. It resembles the raw cotton linters, but it becomes totally unrecognizable after it is mixed with other ingredients and the necessary transformation into Celluloid has taken place. This conversion of the fibrous nitrocotton into solid mass capable of flowing under heat or pressure was the problem which confronted the ingenuity of the inventors shortly after its discovery.

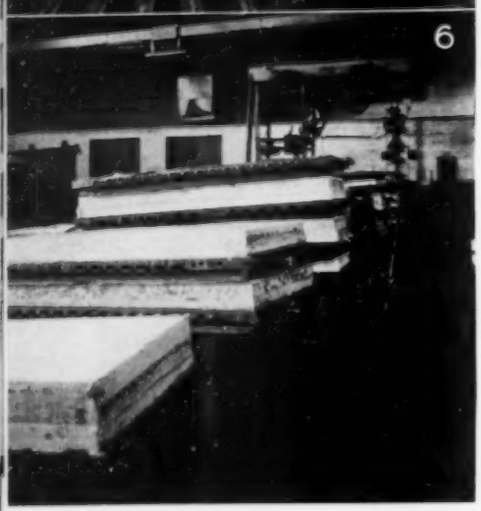
Mention has already been made that John Hyatt had started in 1868 to coat billiard balls with a pyroxylin solution. While engaged in this phase of the work he observed that camphor, when melted by heat, was a solvent in itself for nitrocellulose. Collaborating with his brother, Isaiah Smith Hyatt, an ex-editor, they made a close mixture of ground nitrocellulose, flour of camphor and pink coloring matter. When this mixture was molded in a die under heat and heavy pressure, it resulted in a dental plate of good appearance. Isaiah, the more scholarly of the Hyatt brothers, dubbed it Celluloid, which is a combined word of cellulose plus oid (form). The word Celluloid was registered in 1873 by this American inventor, John W. Hyatt, who was awarded in 1914 the Perkin Gold Medal for his notable contribution to the world. The name still remains a registered trade mark in the U. S. Patent Office as exclusive property of the Celluloid Corporation. Today, although Celluloid is a trade mark, it has been universally used as a generic term by the average layman to designate many of the pyroxylin plastics in use.

Hyatt's mixing bowl and die were the first celluloid factory and incidentally the first and only plastic factory in the world. This was the humble beginning of a progressive



Celluloid's Newark plant (Circa 1878). This was preceded by plants used for a short period in Albany, New York, and an earlier Newark plant which was destroyed by fire. Phoenix-like, the buildings rose from the ashes.






# HOW TO MANUFACTURE CELLULOID UNSEEN FACTOR—66 YEARS EXPERIENCE

FIRST STAGE

Cellulose in the form of cotton linters is treated with a combination of nitric and sulphuric acids to render it soluble and workable. The resulting product is called nitrocellulose or "pyroxylin."

SECOND STAGE

"Pyroxylin" is treated with suitable solvents combined with camphor to make a plastic dough-like substance. Camphor is termed as a plasticizer and imparts the properties of plasticity or moldability under the application of heat and pressure.

THIRD STAGE

(See Picture No. 1)

The gelatinized or soaked product is manipulated in a kneader or dough mixer to distribute uniformly the solvents and hasten colloidalization.

FOURTH STAGE

(See Pictures No. 1, 2 and 3)

Since the kneaded product is contaminated with foreign substances, it is submitted to a filtering operation to remove objectionable impurities.

FIFTH STAGE

(See Picture No. 4)

This plastic mass after it leaves the filters is manipulated between a pair of malaxating or "converting" rolls to homogenize and effect a better dispersion of ingredients and also permit a multitude of coloring effects. The rolled material is finally smoothed up into a crude rolled sheet.

SIXTH STAGE

(See Pictures No. 5 and 6)

A suitable number of rolled sheets are placed upon one another in a "chase" or steel box where they are consolidated under heat and pressure into a solid block from which sheets are subsequently cut.

SEVENTH STAGE

(See Pictures No. 6 and 7)

The blocks or cakes of Celluloid, known as "heats" after cooling to the correct temperature are cut into sheets of suitable thicknesses on a planer knife, and thereafter subjected to a seasoning process to remove volatile solvents such as alcohol.

EIGHTH STAGE

(See Picture No. 8)

The hardened and seasoned sheets are polished and "finished" in various ways to produce their transparency, brilliancy and different finished surfaces.

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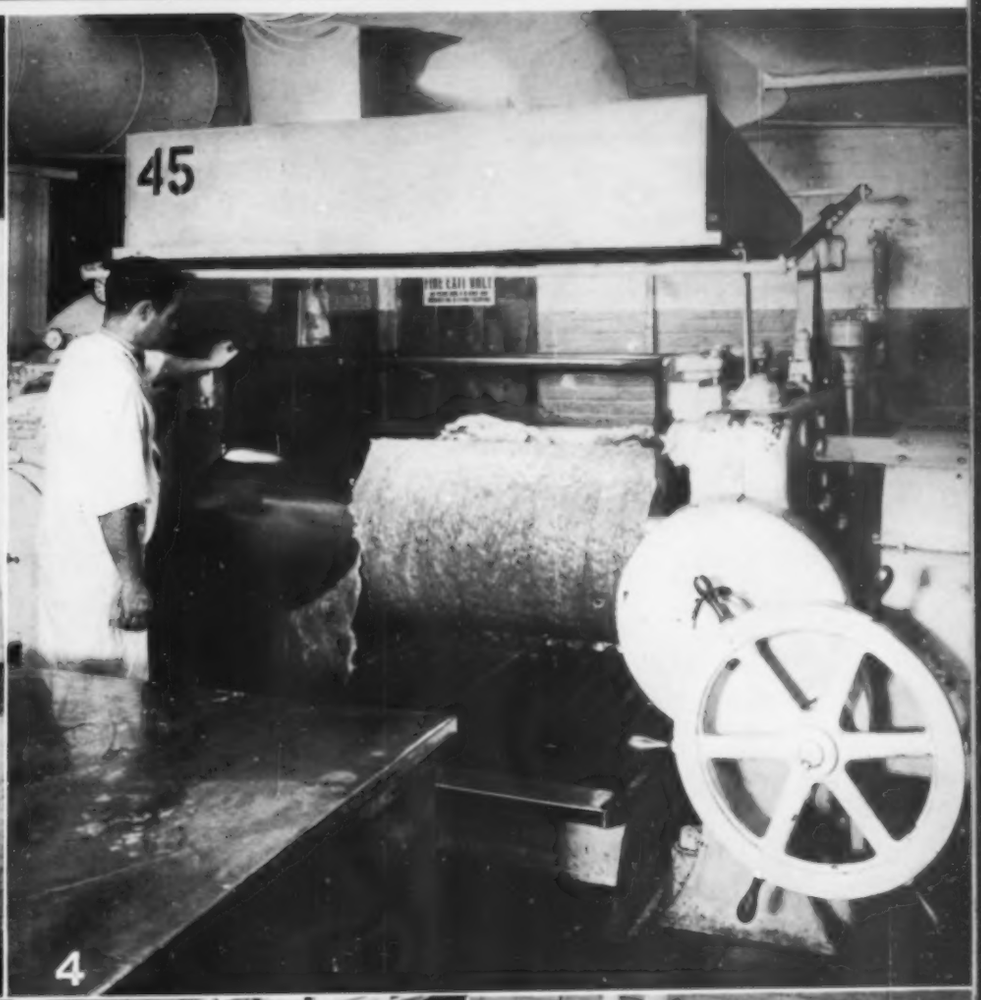


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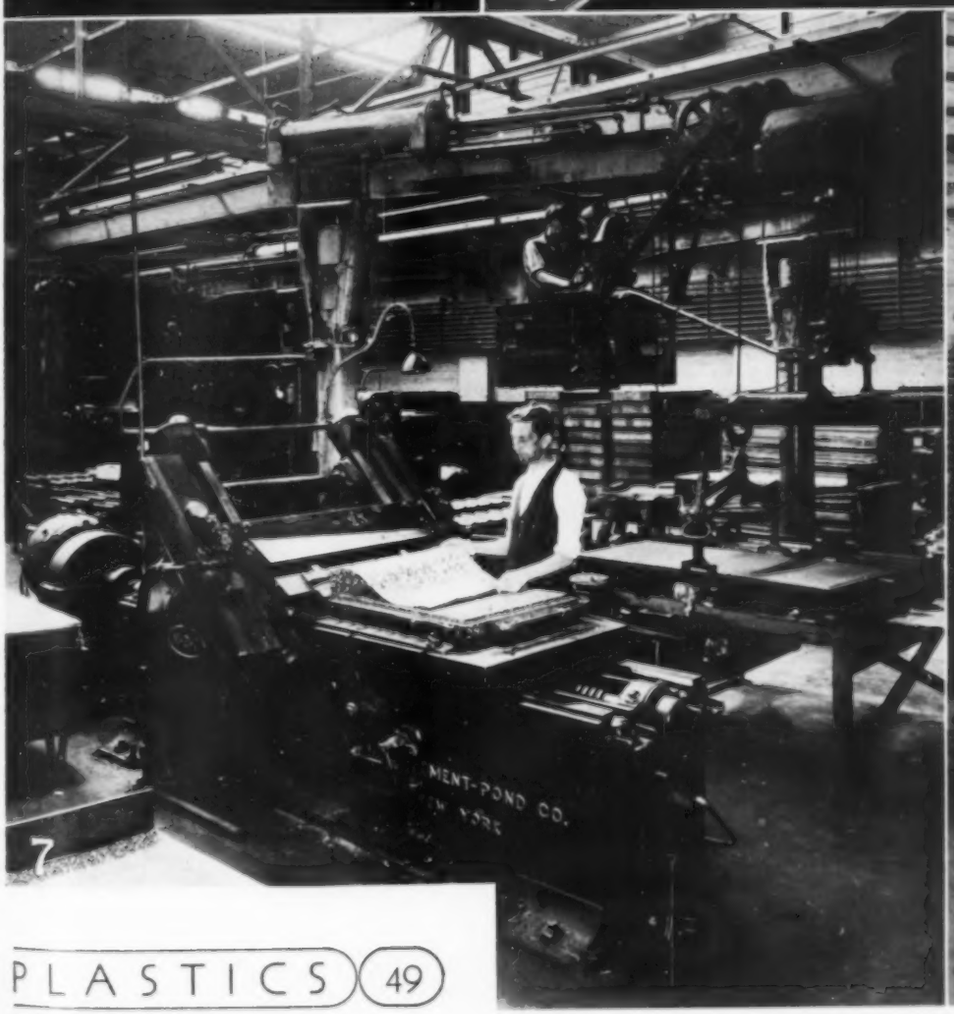


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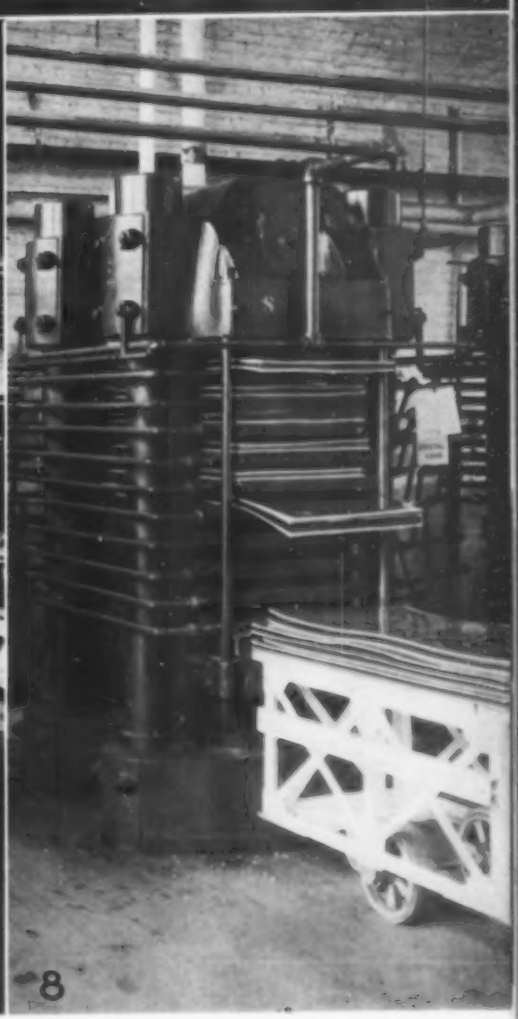

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# NO SHIPS, NO SHOES, NO SEALING WAX, BUT

—the 25,000 and more applications of Celluloid Corporation products include practically everything from cabbages to kings. Thirty-three uses are illustrated above. Note the Celluloid dental plate in the lower right hand corner. This, one of the first and at one time the most important of Celluloid's uses, continues today to provide an outlet for Celluloid. Vastly more important, however, are Celluloid Corporation's activities in providing materials for the other articles here shown. The Celluloid family (Celluloid, Lumarith, Ivaleur, H-Scale, Fill-Base and Protectoid) covers practically the entire range of present day plastic compounds.

industry. The solitary boy employee of the Hyatt's, John H. Stevens, who witnessed the exultant inventors at the original test of their process continued his association with this industry and made further contributions to it, as evidenced from the numerous patents assigned to the Celluloid Corporation. The Hyatt process is still adhered to with some modifications and refinements in the art of manufacture. The accompanying illustrations with their titles tell the story of "Celluloid's" manufacture clearly and concisely.

Soon after the discovery of "Celluloid", the first efforts of the brothers were directed to supply to the dental trade the much needed plates. Therefore, the Albany Dental Plate Company was organized in Albany, N. Y. There are some very interesting testimonial letters in the Company's files attesting to the excellent quality of celluloid. The following letter is typical of many that are found in these archives:

Gentlemen:

I use Celluloid for partial plates, below as well as above, with as much satisfaction as in full sets; have no plates to warp, and fewer teeth to break off than with the use of rubber. I could not be induced to return to the use of the latter.

H. D. BOYD,

Troy, Alabama, Feb. 27, 1878.

The original company was quickly followed by the Celluloid Manufacturing Company which was established in 1872 through adequate capital furnished by Marshall C. Lefferts of New York City, who was attracted by the possibilities of this interesting plastic which could be made in all forms: sheets, rods and tubes of continuous lengths in any color or configuration desired. The modern synthetic-resin plastics of today are still striving for the same goal. The Celluloid Manufacturing Company is the original

John H. Stevens, one time Hyatt office boy, long time Hyatt associate and president after Hyatt of the Celluloid Corporation, contributed to numerous improvements in Celluloid manufacture.

corporate name of the present Celluloid Corporation.

Thus, fortified with a moderate capital the company operated for a short while in Albany, N. Y. Shortly thereafter, in 1873, it moved to Newark, N. J. and began operations in Mechanic St. with 150 employees. The building in which the company was housed was small indeed. Had it been possible to foresee the rapid growth and expansion of the company, its quarters would have located elsewhere. But, through a set of circumstances, beginning with the destruction of the building in Mechanic St., caused by fire, the company built its first building on Ferry St., Newark, in 1875, between Ashbridge and Westcott Sts. Subsequently, as the company prospered, additional buildings were built and at one time the area occupied was considerably over 30 acres, with approximately 3,000 employees. At present, the activities of Celluloid Corporation are confined within the limits of 27 acres with its main office at 290 Ferry Street.

For almost forty years Celluloid Corporation continued to manufacture Celluloid before other plastic materials came into use. During this period, entirely modern industries came into existence, using Celluloid in many and diverse fields. It is almost impossible for a person not to come into some daily contact, either at home or at work, with an article made of Celluloid. To enumerate the many applications and the uses to which the material has been placed is likewise a difficult task. It has been estimated that Celluloid has found entry into more than 25,000 applications.

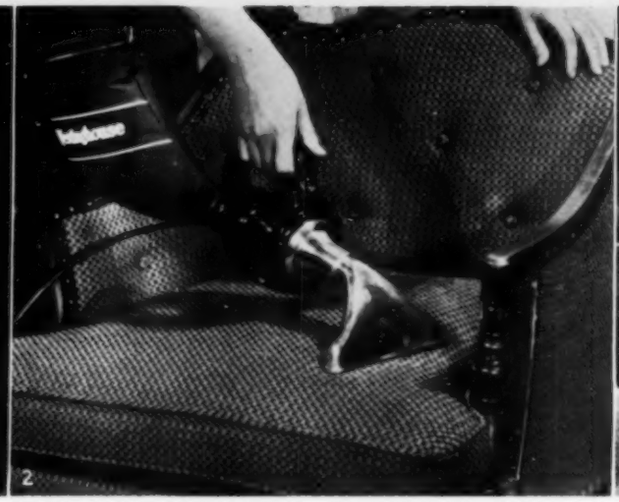
The wide, sudden and continued demand for a true thermoplastic material such as Celluloid increased the character of its application to so many diversified fields that it became quite apparent that much research must be done in order to meet the growing needs of industries for plastic materials. Celluloid, therefore, gave birth to an industry stirring and exciting the imaginations of chemists and engineers who have worked toward the improvement and amelioration of the original product. Thousands of patents have been taken out in feverish attempts to compete with or supplant Celluloid.

The influence of Celluloid is directly traceable to the important changes and devel-

*(Continued on page 66)*

An early group photograph of Celluloid Corporation executives and employees. Probably taken during the Struggling Seventies. A group photograph taken today would show close to 3,000 faces.

1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# FOR DUTY AND BEAUTY

"New lamps for old" is the modern magic expressed in the utilization of plastics. Used either as a substitute for materials formerly employed in the production of various utensils and devices or for entirely new products, plastics have been receiving increased acceptance by manufacturers. The inherent properties of plastics, their adaptability to design and the economy with which they can be utilized are outstanding factors which have won consumer recognition. The list of products in which plastics are used, wholly or in part, even though most extensive and vieing with that of any other material, is constantly growing.

Here is a lavish field for the designer, for in the use of plastics he has an opportunity to express color, symmetry and interpretation to his soul's content and, at the same time, attain utility and convenience which are regarded today as so important to sensible designing.

In plastics, the manufacturer of devices finds the answer to many of his problems that center about the supply of adequate materials. In some instances they furnish him with a substitute, more economically desirable; in others he is able to supplement the properties of former materials with additional advantages.

Constant research and improved processes have widened the manufacture and utilization of plastics, so that today it is no longer a question as to whether or not those materials can be used. The development of plastics has been such that the services of the industry are almost a logical answer to the boast "If I cannot find a way I will make one."

In other words, where it has been found that a plastic offers certain desirable properties which might indicate its use, it has been possible to develop a plastic compound that will meet all the necessary qualifications. It is this ability—that of meeting the needs for efficient and thoroughly utilizable materials—which has attracted producer and consumer to plastics. The list of applications for plastics, constantly and consistently growing, is already equal and in many cases surpasses that which is recorded for other materials. And this progress in plastics has taken place in a comparatively few years—for their commercial beginning dates back to 1866.

There was a time when the consumer was content—or so thought he was—with that which satisfied his practical needs. If a utensil was such that it performed its function with more dispatch than that which had been previously attainable, it sufficed for the time being. But gradually came the realization that the things which he used daily or otherwise could not only be made serviceable but good-looking as well.

To the consumer, utility and attractiveness will always be of paramount consideration in his or her acceptance of any product. Because of this, MODERN PLASTICS has chosen to designate this department "For Duty and Beauty," including therein each month a selection of those products which are of timely interest.

1. These democratic kitchen implements successfully respond to a new deal in handles. Non-inflammable, highly acid resistant, odorless, tasteless. No chipping, no burning and obtainable in many colors. Color is more than surface deep—running all the way through. These qualities are gained by replacing the customary materials with Catalin.

2. Westinghouse further lightens the housewife's burden with a hand vacuum cleaner only five pounds in weight. The motor frame and housing are of molded reinforced phenol resin. Lighter than aluminum, obtainable in a limited range of colors and elimination of finish and machinery make it an economical as well as a practical instrument.

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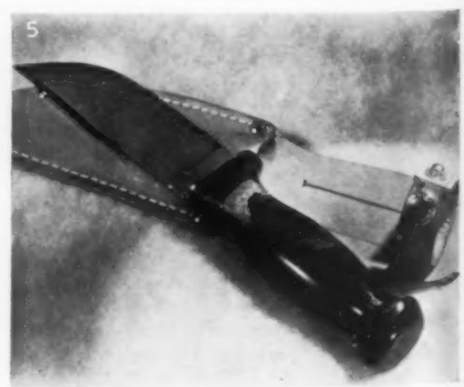
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3. You make your own the way you like it. That's the function of this interesting coffee dripolator, the molded sections of which are produced in phenol resin. When the tumbler is placed in the molded holder, and the dripping unit mounted on top, it requires merely the addition of hot water to prepare coffee to meet the individual's taste. This type of dripolator is used extensively abroad. Photo, courtesy of Bakelite Corporation.

4. In a sincere effort to eliminate the unsightly discs of blotting paper which serve as coasters, the American Record Corporation has produced a well designed Bakelite molded coaster, available in a wide range of attractive colors. These coasters have a hard lustrous surface and may be easily washed, retaining their shiny appearance indefinitely. These offer an excellent opportunity for trade mark identification, and are available as premium items, for complimentary distribution or for regular sales.

5. Hunters will be keen about this new knife produced by the Western States Cutlery & Manufacturing Company of Boulder, Colo. It consists of a stainless steel blade, the shank of which is embedded in a durable and attractive molded phenol resin handle. The latter is in a variegated effect and is designed to withstand considerable rough handling. Since the knife shank is imbedded in the handle during the molding operation it cannot become loosened in service. Photo, courtesy of Bakelite Corporation.

6. The use of plastics for book cabinets is not new, but in this instance the molded case measures 13 in. by 13 in. and is $8^1/_4$ in. deep—one of the largest molded pieces ever made in this country. It is molded of Bakelite by the Boonton Molding Company who supplied the photo.

7. The tea kettle illustrated is a unit in the new "Kook King" line of kitchenware made by the Vollrath Company of Sheboygan, Wis. A sturdy kettle made of extra heavy steel with triple coated enamel surface in highly lustrous black and white effect, it has an easygrip, heat-resistant Bakelite molded handle which remains comfortable to the touch at all times. Through a lever arrangement the handle can be locked in an upright position or moved to either side of the utensil. The kettle is available in $3^1/_2$ and $4^1/_2$ quart capacity.

8. We are seeing many instances in which products are designed so as to unite the old with the new and still achieve complete harmony. We all remember the whir of the old fashioned coffee grinder, more dependable than the alarm clock as a clarion call to breakfast. In Germany, from whence comes this example, they have given the old grinder a new dress, employing molded phenol resin in two tone effect for the entire case, in a pleasing modern design. Photo, courtesy of Bakelite Corporation.

9. And here is a useful as well as decorative desk accessory. The Frank A. Weeks Manufacturing Company of New York has recently announced a new hand blotter constructed entirely from molded Bakelite in a walnut mottled effect, also in black and mahogany.

10. The Kleenti tea strainer has recently been announced by the Kleenti Company of New York. This device fits snugly on the spout of the teapot, straining the tea as it is poured into the cup. It eliminates the use of the old, ungainly tea strainer. It also fits over broken spouts, giving new life to old and cherished teapots. The device is produced in brown molded phenol resin which withstands constant exposure to hot liquids, yet retains its fine appearance indefinitely. It is now being distributed as a premium by Thomas J. Lipton, Inc., thus linking one of the world's finest teas to a modern and exceedingly clever device. Photo, courtesy of Bakelite Corporation.

9

10

# YOU'VE GOT TO GET CONTRAST

By FRANKLIN E. BRILL

A well-known industrial artist was talking about plastics-design recently. "Contrast," he said, "is what plastics needs. Shapes tend to take care of themselves, and excess decoration will gradually pass. But you've *got to get contrast*."

Contrast is rather difficult to get in molded plastics, because of the normal monotone of the material. If it doesn't come naturally we should strive for it consciously, because lack of it tends to bore the eye, and a bored eye never buys. Also, when it's lacking, amateurs try to make up for it by the use of fake "wood effects," which in themselves connote cheaper substitutes. But let's take this elusive "contrast" apart, and see what's inside.

We can get contrasts between surface textures, colors, material and shapes. As an example of texture contrast, a smooth molded camera can have a band of rough-textured multiple ribbing; color contrast—a black molded clock can have a white molded base or bezel; material contrast—a smooth shiny lamp base can have a nubbly tweed shade; shape contrast—a squarish radio cabinet can have big rounded knobs and dials.

EXPERIMENTS IN CONTRAST. Let's take electric clock cases. There's no more suitable material for clock cases than plastics, but since the high point a few years ago when they all used molded cases, plastics have lost much ground in the clock field. The reason is obvious: In the electric clock heyday molded cases were copied after the older wooden cases, and when molded in solid colors they were usually found to lack contrast. Imitation wood effects were then tried, and molders and clock-makers were so intrigued at this ingenious deception that they forgot what would happen: plastics would be considered a cheaper imitation of wood, and clock-makers would soon drop them. Today most of them have.

Let's design a little mantel or boudoir clock, and get some contrast into it. How about taking a black molded cylinder three or four inches in diameter and three inches high—a shape like a cosmetic jar. Molding it hollow, we can engrave the numerals on the bottom of the mold, which should be etched to give a dull finish, and have the side walls project beyond the indented bottom. When it comes out of the mold, wipe in the numerals with white, lay it on its side, insert the works and shiny gold or chromium hands, and snap in the crystal and bezel. You've got your clock, but it needs legs and a bit of contrast. You could take a gold or chromium stamped strip, bend it around the middle of the cylinder, lock it underneath and let the ends project flat an inch or so for legs (contrast of materials). Or you could eliminate the band, mold the cylinder in two halves, front black and back white, screwing the back on like a jar cap, and having unobtrusive bumps for legs molded onto either half (contrast of color). Either way would be pleasing and either would give you a smart clock case for a dime or fifteen cents. Try turning out a wood and foil model on a lathe, or sketch it; and if you don't like the cylinder try a cube or an octagonal form, or a chamfered corner cube. If you get stuck again for contrast, try wrapping a gay Roman-striped wool ribbon around the middle of the case, gluing it into a recess molded into the case (contrast of color, texture and material all in one).

Often your contrast comes naturally, from the components of the product themselves. Let's say we want a low-priced, rich-looking home thermometer, of the mercury-column, wall type. The scale is probably metal, with graduations and satin-finish etched in. A simple and practical form is a hollow half-cylinder, halved lengthwise, and just as long as the scale. A polished mold will give a high lustre to the piece, whose function dictates black material, and when the column and pre-curved scale are fastened on, you'll find good contrast between the shiny black molded back, the dull-finished metal scale and the shiny glass column. You'll also notice that the vertical highlights on the molded surface are visible at any angle (another contrast), yet they always stay away from the column and scale and don't distract one, and the scale, being curved, is visible from the side. On cheaper thermometers the metal scale can be eliminated, and the graduations and numerals can be molded in and pigment wiped in—a simple operation and still the richness and chip-proof surface of the plastic will be retained.

Or how about a midget radio cabinet? Several have been molded, not too successfully, because on big pieces like this the sleekness of molded plastics overwhelms our pine-loving American—with his preference for soft textures in his living room—so we'll have to tone down that sleekness. We'll have to get contrast, too, a quality lacking in most molded cases. Let's let the plastic material be the shiniest part: let's mold it in the regular rectangular cube-shape, smooth and unadorned, edges rounded slightly. We'll put the grille *inside* or use web or wire-cloth instead and we'll cover the grille from the bottom to top with thin monk's cloth or nubbly homespun, and continue it in a band right over the top, tucking it into the back of the case. For knobs we could use spheres or hemispheres of gay translucent cast-plastic or molded cellulose, in light colors, and we may find it necessary to fasten our cloth in with satin-finished metal beading. A wide variety of color combinations suggest themselves, which will permit color-contrasts between knobs, case and cloth, which already have material and texture contrast. Perhaps the cloth could be laid on in a horizontal band from the right edge of the grille toward the left in a smooth sweep over a very rounded left-hand edge to the back. Generally speaking, darker colors are safer for the cabinet, getting the gayer colors in the components.

HIGH-LIGHTS: When you sit down to design a molded plastic object, you'll find that the predominating quality of the material is a rich, sleek, lustrous surface, formed automatically in the mold. This is plastics' inherent stock-in-trade, so watch it carefully. If you have components in shiny metal or glass which will show along side of the plastic, you can afford to subdue the lustre of the molded parts. If the components are dull—like wood, porcelain, paper, rubber, bronze—play up plastics' normally shiny lustre. Actually, lustre is mainly a matter of high-lights—points on an object which catch light. Curved, ribbed or engraved surfaces bring them

*(Continued on page 78)*

**Deep-sea fishing reel ends molded from Tenite by the Reynolds Spring Company**

# TENITE

was chosen for these Bronson fishing reel ends because of its ability to take metal inserts, high shock-resistance, ease of drilling, durability, and transparency. Tenite is a thermoplastic made from Eastman cellulose acetate. It is supplied in both molding sheets and granular forms, in plain and variegated colors, and in any degree of transparency. Its extraordinary strength and unlimited color range adapt it to a great variety of industrial and decorative purposes. Write today for samples and information about the properties of Tenite.

**TENNESSEE EASTMAN CORPORATION** *(Subsidiary of Eastman Kodak Co.),* **KINGSPORT, TENN.**

# WHICH PLASTIC TO CHOOSE?

Modern industry offers many types of plastics from which a selection may be made. Each type has its advantages as well as its limitations. To make an intelligent choice, both designer and user should know the properties of each type. To aid readers of MODERN PLASTICS in making a selection, a series of articles on each type will appear in these columns. These are prepared by Herbert Chase, an engineer who has followed plastics developments for many years and who writes with authority on this subject for leading American and European publications.

## PHENOLICS—LEADERS AMONG MODERN MOLDING MATERIALS

By HERBERT CHASE, M.E.

Phenolic molding compounds, known to users under such trade names as Bakelite, Durez, Textolite, Resinox, Indur, Makalot and the like, are the most widely used of modern molding compounds for several reasons. They possess many excellent qualities, are low in cost, available in many types and colors and have withstood the tests of more than a quarter century in diversified applications. Originally this type of material was employed largely for electrical purposes and it is still among the most important materials used in the electrical industries. Today, however, its use has extended into uncounted applications in which it is entirely divorced from electrical or dielectric purposes. In other words, the phenolics have become recognized as excellent structural materials, comparable in many respects with metals, but possessing very different characteristics. In them the designing engineer and production man find strength, light weight, resistance to moisture and to other deteriorating factors, as well as ready fabrication into diverse but accurately sized forms rapidly manufactured on a repetitive basis. In them also, the designer finds a medium readily converted into pleasing forms affording beauty of finish and a variety of color effects.

It is true, of course, that similar qualities are obtainable in other plastics and these will be discussed in later articles. Nevertheless, the phenolic type, one of the earliest of the modern plastics, combines so many advantages that it continues to hold perhaps the most prominent place among all the plastics.

Phenolic types of plastic materials include, besides the molded forms, both laminated and cast types. In addition, there are also such types as cements, baking-type lacquers, enamels and varnishes, bonding resins for abrasive wheels, denture resins, coatings for cloth, etc.

This article, however, relates only to the molded forms. The plural is used advisedly, for there is an almost endless variety of molding compounds in which the phenol-formaldehyde type of resins forms the binding plastic element. Although these resins—which look in their raw form very much like amber but are very different both in composition and qualities—can be molded in some cases in their pure form, they are nearly always mixed with a filler of some kind. This results not only in a less expensive molding compound, but in one which is stronger and possesses other advantages. In the

HEAT RESISTANCE. Rome Brass & Copper Company found molded plastics an ideal material for teakettle handles. This one, molded around the metal bail, offers a smooth, comfortable, always cool and permanently shiny surface. All photographs which accompany this article have been furnished through the courtesy of General Plastics, Inc.

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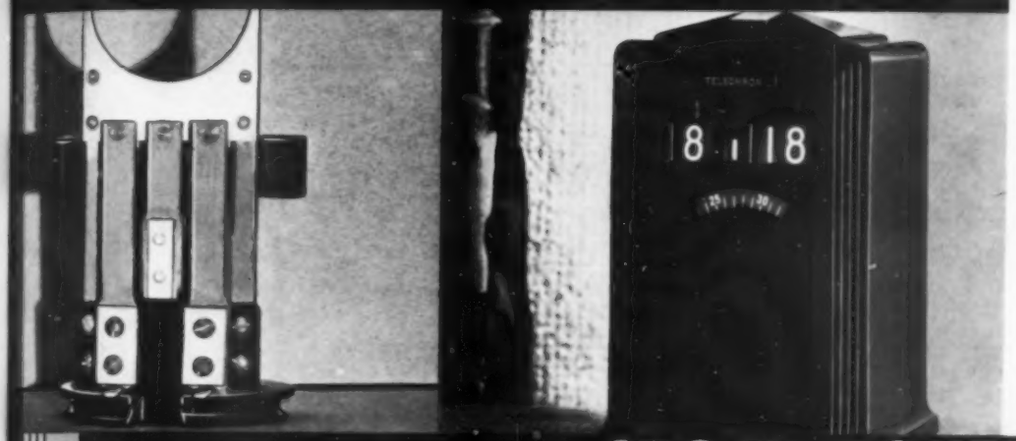


## STOCK BOXES

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## STOCK TABLE WARE

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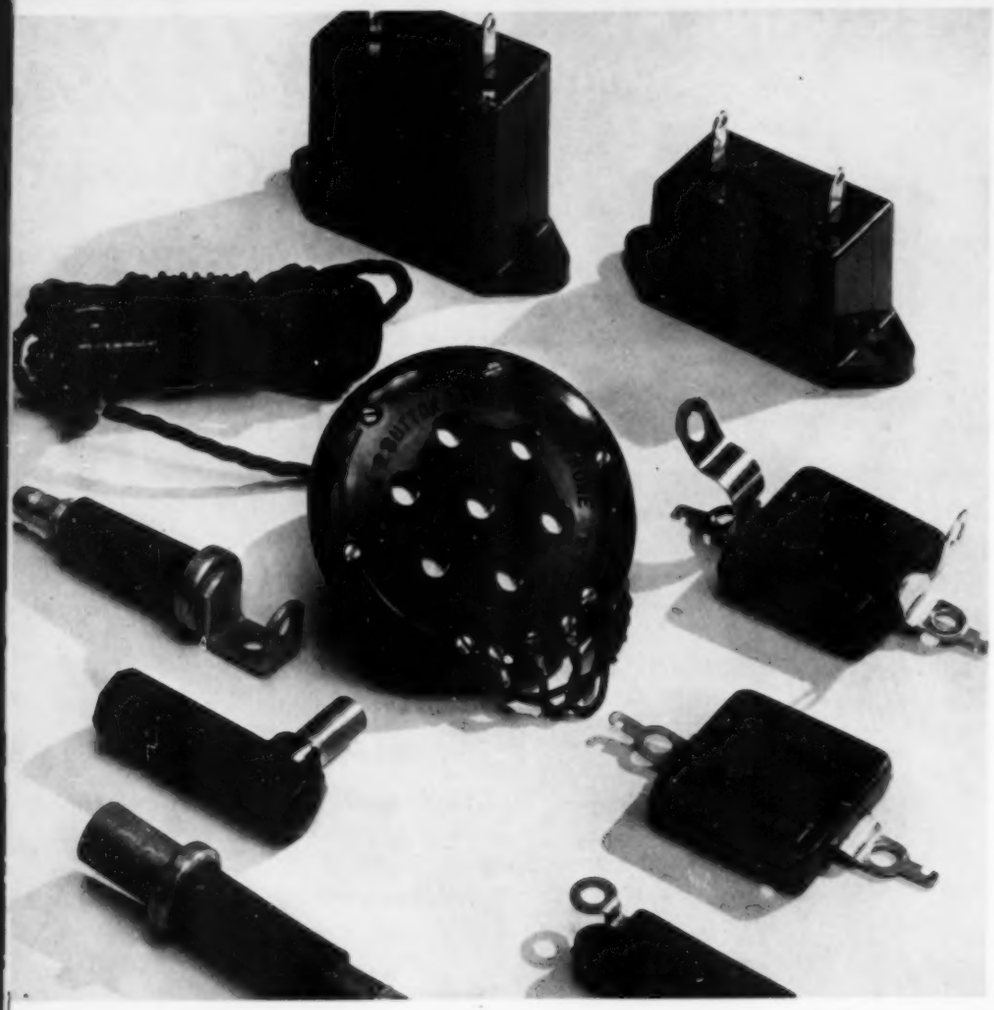


DIELECTRIC STRENGTH. A group of radio parts and components from Universal, Aerovox and other manufacturers, showing how molded plastics have been used to combat leakages in high frequency electric current. Low power factor, obtained in several phenolic plastics, is necessary with frequencies such as used in modern broadcasting.

molding process, the resin is "fluxed" or reduced by heat to a liquid or plastic form. It then undergoes a chemical change causing it to set and harden into an infusible and insoluble mass, forming the permanent molded article ready for use by the consumer. In this curing process, the filler, including any coloring matter which is mixed with it, and the resin form one homogenious whole possessing the properties referred to in the accompanying tabular and other data.

During the molding process, which is carried out in a steel mold heated, usually with steam, and subjected to heavy pressure, the molding compound sets permanently and cannot be softened afterward by subjecting the molded piece to heat. In this respect the phenolic compounds, often referred to as thermo-setting compounds, differ from some other molding compounds, to be dealt with later, the latter being called thermo-plastic, as they do not set finally in molding but may be softened again if subjected to sufficiently high temperatures. The thermo-setting qualities of the phenolic materials give them a desirable stability under heat and make them suitable for many applications in which thermo-plastic compounds would not meet requirements.

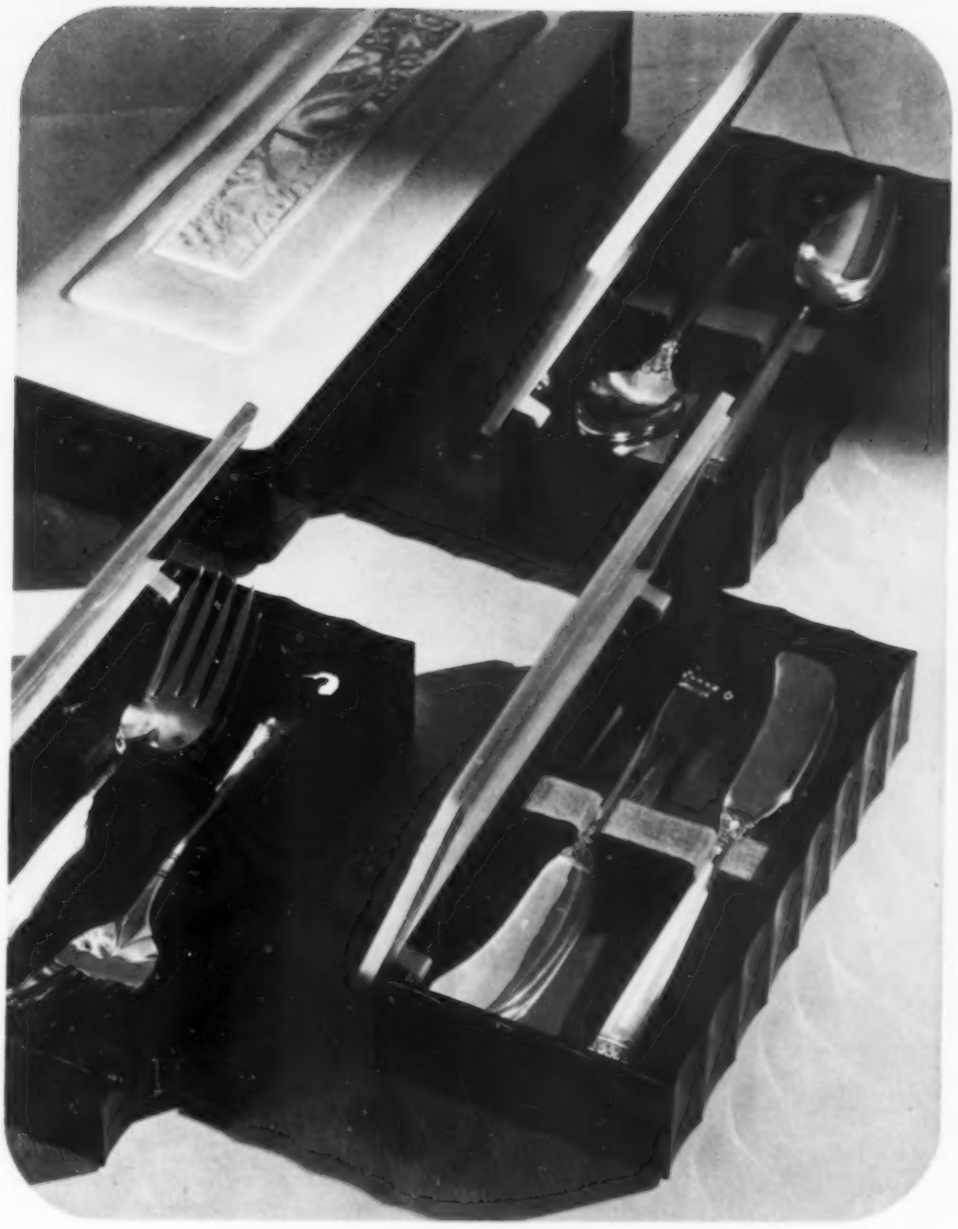
Although transparent or translucent phenolic moldings can be produced from certain forms of pure phenolic resins, such work is still considered experimental. Filled compounds generally incorporate an opaque filler and a pigment, which is also opaque, so that the molded piece too is opaque. Wood flour is the filler most commonly employed, as it is light and inexpensive and serves its purpose well. The molding possesses greater heat and moisture resistance, however, if the filler used is asbestos, hence the latter is employed chiefly for moldings that must withstand moisture or high temperatures (up to around 500 deg. F.) or both. Such moldings are heavier and cost more than the type using wood flour. Powdered mica is sometimes employed as a filler, especially in moldings requiring high electrical resistance (that is superior dielectric qualities), and graphite is employed when the surface of the molding must withstand frequent rubbing contacts, as the graphite acts as a lubricant.

Constant contact with water is detrimental to these materials but one manufacturer now offers a non-hygroscopic compound of excellent quality and of greater surface luster than the standard wood filled compound.

Nearly all phenolic resins are either dark in color or tend to darken when exposed to light, and this may result in causing the molding to darken if it is light in color originally. For this reason, most phenolic moldings are made in black or dark colors. By the use of heavy pigmentation with light pigments, light phenolic moldings, even of ivory color, are sometimes made. Some light colors, especially when made with special forms of resins, are fairly permanent in color. Others fade or darken with age or light exposure. In general, the light colors or even dark colors are more costly than the natural brown or black forms, as are the types made to simulate such woods as mahogany and walnut. Practically all brown molding materials today are pigmented.

Most phenolic moldings are quite resistant to moisture, as well as to some chemicals, such as dilute acids, oils and solvents. Prolonged and continuous contact with moisture, however, will cause most ordinary phenolic moldings to crack and some forms to "bleed" if left in contact with alcohol and certain other solvents. For this reason, if continued or if other abnormal contact with moisture or with any liquid is required, a special type of phenolic molding compound, usually designed for the purpose and generally having a higher-than-normal resin content, should be selected. Such compounds are available, for example, for the molding of jars such as are used for moist cosmetics, and certain special resins are used also for the molding of caps for liquor bottles which may come in contact with alcohol.

Tests of phenolic moldings made by the Bell Telephone and other electrical laboratories show that molded phenolics often absorb considerable quantities of moisture from the air—more in some instances than if submerged in water for an equal period. This absorption lowers the dielectric (insulating) properties of the material and may reduce its insulation resistance to 20 per cent or less of that of the dry molding. When this change is a



# AMERICA'S PREMIER CUSTOM MOLDERS

UNDOUBTEDLY two of the finest molded designs of the year are these boxes for Community Plate silverware which we have been privileged to manufacture. The instant acclaim they have won from molding experts, from designers and packaging critics, from dealers and from the public at large, has fully justified all the care and attention which both Oneida Community and the Diemolding Company have given to their production.

Yet these boxes are in no sense unusual show-pieces. They are typical of the daily output of the Diemolding Company's staff.

The men who have created these and so many other outstanding molded products and parts—their years of experience and record of achievement—all these are at your call, ready to aid you in the planning and preparation of equally fine molded products or parts.

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To relate these general facts to your particular problem, write to the—

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CANASTOTA NEW YORK

factor of importance, it is well to select that type of material having the lowest water-absorbing properties.

In certain other applications in the electrical field, resistance to heat and especially to arcing is important and requires a special phenolic compound. This applies to certain parts of timers used in automobile engines and, as to heat resistance, to heater plugs such as fit into flatirons, toasters and other electrical heating devices.

Many mechanical and some other parts molded from phenolics are required to have high shock resistance so that they will resist breakage if dropped or struck a sudden blow. Parts of this type should be molded from phenolic compounds in which small pieces of fabric form the filler, as this greatly strengthens the piece and makes it much more shock resistant than the common wood-flour-filled type.

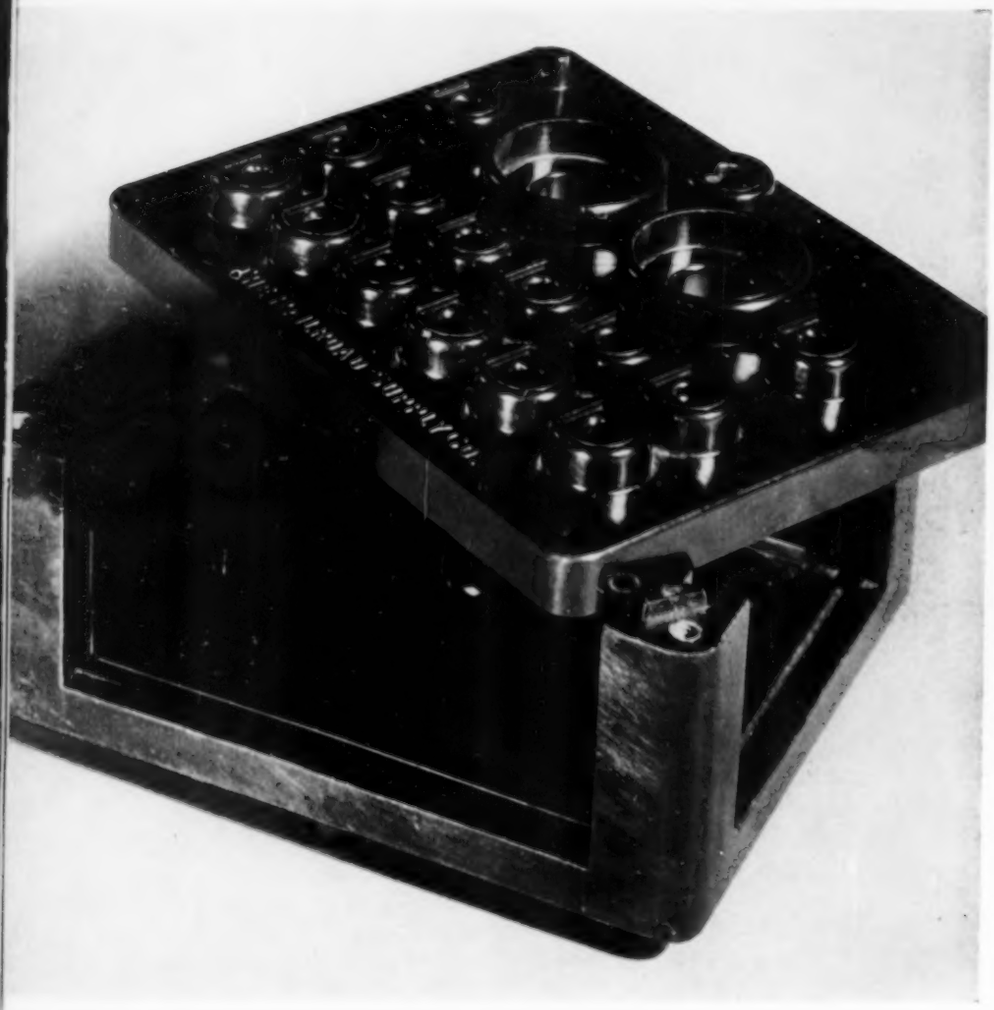
Phenolic moldings which are subjected to tension or compression in service are not so strong as most common metals, but compare fairly well in this regard with certain of the softer metal alloys, such as those of tin and lead, for example. On the other hand, the molded part weighs, as a rule, about one fifth as much as steel or cast iron or brass and about half as much as aluminum, when the same dimensions are involved. For this reason moldings are often used for portable devices such as cameras, projectors and other optical instruments, carrying cases and the like as a means of saving weight.

Another factor which influences the selection of phenolics as compared to certain other molding compounds is their comparative freedom from what is termed "cold flow." Many plastics yield when subjected to continuous load, especially when the temperature to which they are subjected is much above that of the ordinary room. Thus, if the plastic is subjected to pressure, such as that exerted when a screw is tightened against it, and the plastic cold-flows as a result, the screw will become loose. This is an important consideration in some forms of electrical and mechanical applications, especially when a contact which should be tight becomes loose as a result of cold flow. Phenolics are subject to some slight cold flow, but much less than most plastics.

One of the most important considerations entering into the selection of the material used in many products is its appearance and its ability to maintain this appearance or finish in the fabricated form. In this respect most plastics offer a great advantage in that they come from the mold in substantially finished form and require, as a rule, no applied finish to make them look well and remain so in service. Nearly all metals tarnish or corrode to some extent unless protected by an applied finish, but there is no corresponding action on the molded part in most cases. As the finish on many small metal parts often costs as much or more than the piece itself, there are many cases in which moldings are selected in place of metal largely or wholly because they require no applied finish.

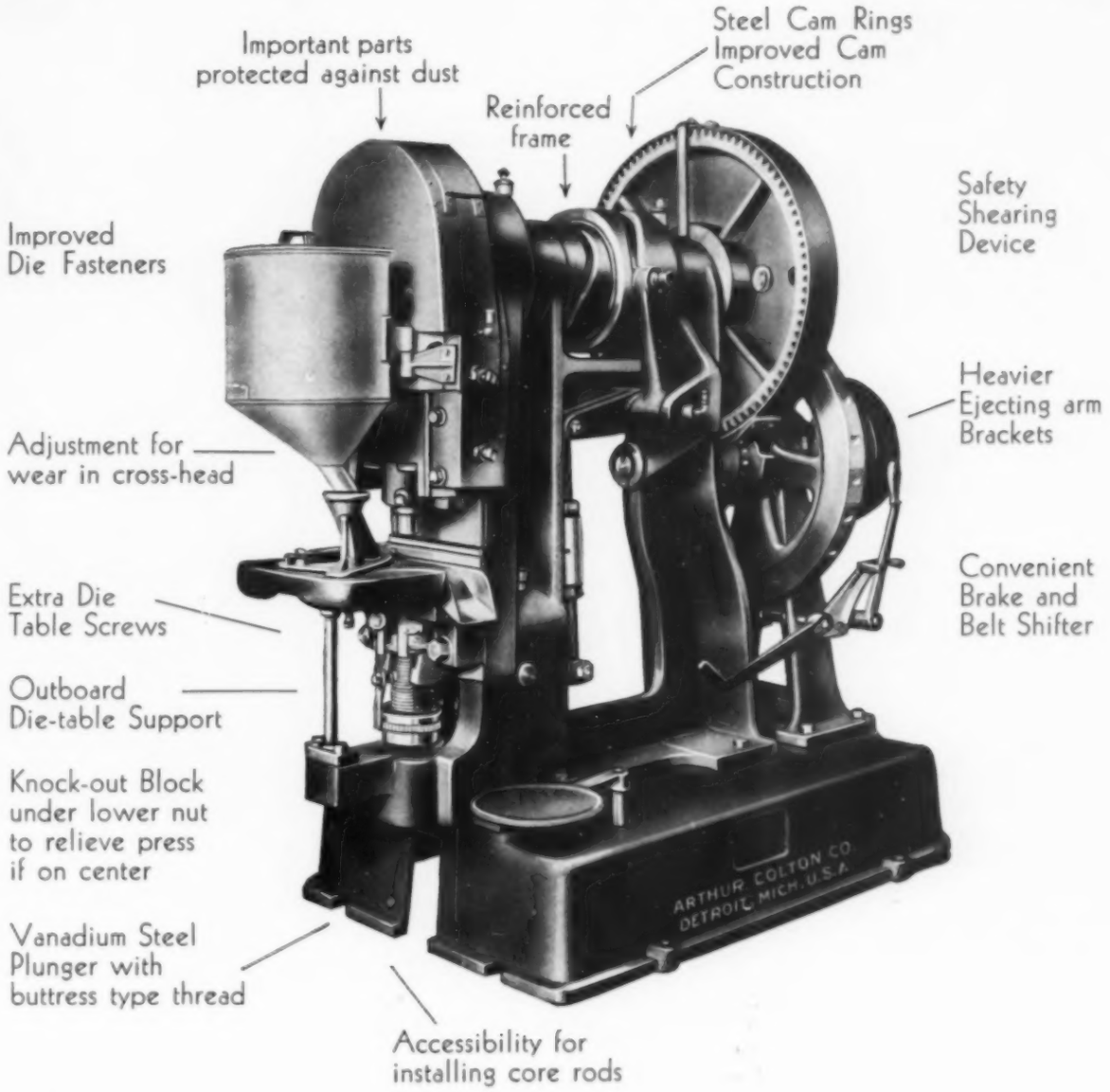
If the mold is well made and properly polished, and the molding is properly done, the molding coming from it has an equal polish. Slightly different mold treatment will afford a semi-matte, matte, stippled or roughened surface, as desired, and may be employed to produce a contrasting effect on the same piece if this is wanted. Lettering, trade-marks and decoration of various kinds can be molded into the product when desired.

STRENGTH. Often through proper design, molded plastics can perform feats of strength ordinarily thought impossible. This control wheel of molded Durez feels more pleasant to the lathe operator's hands, never rusts, corrodes, chips and never requires finishing.



CLOSE TOLERANCES. Phenolic plastics have been most generally used in industrial molding where close dimensional accuracy is required. This Railroad Supply Company terminal box is an example in which accuracy of detail and dielectric strength are combined in one material.

# A NEW IMPROVED PERFORMING PRESS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CHEMICAL RESISTANCE. This special ink-well cover requires resistance to the acid contained in ink, in addition to a surface and proof against children's scratching. Resistance to most of the common acids and alkalies is a feature of phenolic plastics.

These facts apply to all moldings, whether phenolic or of other materials, but are properly classed as among the advantages of phenolic moldings when the latter are compared with metal products.

Some grades of phenolic tend to char or show other signs of deterioration if subjected for continued periods to temperatures above 250 deg. F. Other grades, especially those having asbestos fillers, withstand temperatures of 400 to 500 deg. F. without material deterioration. If continued higher temperatures are met in service, some other type of plastic or refractory material is employed.

Arcing of flash-over occurring on the surface of phenolic moldings causes "tracking," that is, leaves a carbonized path through which subsequent electrical leakage is likely to occur, but, as previously indicated, this effect can be minimized by the use of special grades of phenolic compounds. A surface layer of some other plastic, such as cellulose-acetate is sometimes employed to avoid such effects.

Since it is the resin in a molding compound which gives the luster on the surface, an extra luster is sometimes produced by sprinkling the mold surface with a pure resin. In general, this is not necessary, however, especially if the mold is highly polished. Chromium plating of mold cavities is sometimes done to improve their finish and minimize the wear resulting from the abrasive effect of the molding powder. But this is not essential to a good finish.

The speed of production of phenolic moldings varies greatly with such factors as the type and grade of molding compound used, the temperature and pressure employed, the type and method of heating the mold and the maximum section-thickness of the piece. Thin sections always tend to reduce molding time as well as to minimize the quantity of material used. Compounds are often available in several grades of plasticity, but in general this concerns only the molder, so long as the finish and other requirements are met. A soft compound fills out the mold more readily than a harder one but may require a longer cure, thus lengthening the molding cycle, and perhaps will result in a wavy finish. Too stiff or hard a compound may not fill the mold completely and is more likely to displace any inserts or break or bend any pins used to make cored holes.

MOISTURE AND STEAM RESISTANCE. This vaporizer has a molded plastic housing, which is entirely immersed in the medicinal solution. By the use of a special moisture resistant Durez, a housing and cover is made which suffers no ill effect from heat and steam. Dielectric strength is also an asset here.

Curing time has been shortened by improved materials in recent years and can often be shortened further by pre-heating the charge so that a shorter time for heating in the mold is realized. In general, molding cycles run from about two minutes up to 15 or 20 min. in extreme cases where sections are thick or a slow compound must be employed. The time for charging the mold also affects the cycle. Time per piece molded is often reduced by increasing the number of cavities in the mold, as curing time is the same for several as for a single cavity, assuming that an equal speed of heating is maintained. Multiple-cavity molds increase mold cost, of course, and in general are employed only when the quantity of parts needed is comparatively large.

The length of cure may have a considerable effect on the strength of the piece as well as upon its dielectric properties and its finish. Under-curing is detrimental in all respects *(Continued on page 64)*

WEAR RESISTANCE. Few objects receive harder service than door-knobs, and here the integral wear-resistant surface of phenolic plastics shows to good advantage. Despite constant use, the lustrous surface of a plastic door-knob tends to become more lustrous with age, and never chips, peals, dulls or dents.

# COMPANY BOOKLETS

Catalogs, brochures and other industrial literature, now available, is briefed in the following paragraphs for the reader's convenience. Should you desire a copy of any of the publications listed, use the coupon attached.

*No. 79. Dielectric Products Corp.* New booklet completely describes Victron—a versatile resin reported to possess remarkable radio frequency properties—adapted to pressure molding and to the manufacture of laminated insulation—for use in the production of lacquers, varnishes, insulating compounds and cements.

*No. 80. General Electric Co.* Booklet GEA-1658A gives specifications and complete technical data on Textolite roll-neck bearings.

*No. 81. General Plastics, Inc.* A brand new booklet covers the main uses of molded plastics in packaging—caps, boxes, displays, jars, etc. To the packer of materials who is eager to know more about the use of plastics the book brings a wealth of valuable information.

*No. 82. Hercules Powder Co.* Company has released pages 75 to 83 of the nitrocellulose handbook. This addition contains new material entitled "Relation of Viscosity Type Nitrocellulose to Usable Concentrations." Information aids in a better understanding of the relationships between nitrocelluloses of different viscosities, particularly in reference to the concentrations that can be used for various purposes. It will assist also in solving some of the detailed problems involved in selecting nitrocellulose for particular purposes. Three charts (2 separate) are included with these pages. The large charts have been reproduced on heavy cardboard suitable for hanging on the wall. They will be furnished ready for hanging for those who desire them.

*No. 83. John C. Hoof Co.* A splendidly illustrated booklet providing the story of Textolite timing gears for automobiles.

*No. 84. The Synthane Corp.*, manufacturer of Synthane laminated Bakelite, has issued an interesting new laminated Bakelite sample book. In handy pocket size and profusely illustrated, it gives excellent reproductions of sheets, rods, tubes, fabricated parts and possible machine operations. A distinctive feature is the presentation of actual samples of the material. Samples of Synthane have been slipped into paper envelopes on the right hand pages from which they can be easily removed for inspection. On the opposite, left hand pages, the properties, characteristics, colors, sizes, grades and thicknesses are condensed to short paragraphs that can be read in a few moments.

*No. 85. Taylor & Co.* A most strikingly effective use of out-of-the-ordinary photographs illustrating the manufacture and application of both vulcanized and phenol fibre makes the release of this brochure a real event. Need it be said that present users, and prospective users should have a copy at hand?

*No. 86. Westinghouse Electric & Mfg. Co.* Booklet describing uses of Micarta in the paper industry; complete with illustrations and technical data.

*No. 87. Pulverizing Machinery Co.* Com pletely illustrated catalog describing uses Mikro-Pulverizer in plastics and allied industrie To those interested in grinding and pulverizin this booklet brings a wealth of information.

*No. 88. Tennessee-Eastman Corp.* The com plete story of Tenite, a thermo plastic moldin material made from Eastman cellulose acetate described in a 40-page booklet. The book superbly illustrated with photographs of actu applications of Tenite. Every one interested plastics should have a copy at hand.

*No. 89. Fred S. Carver.* Catalog L-2 de describes the Carver laboratory press fo quick, accurate, small scale tests and research plastics and allied fields. The book gives a technical data and prices for various models.

*No. 90. Bakelite Corp.* A 24-page bookl entitled "High Sped Abrasive Wheels Bonde With Bakelite Resinoid." It describes progre made by wheels bonded with Bakelite resinoi in the field of modern grinding.

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## MOLDED TABLEWARE A STOCK ITEM

The Northern Industrial Chemical Company of Boston has completed a set of molds for tableware in Beetle, and has organized to market the line to department stores, institutions, etc., from stocks maintained in Boston. With permission of Synthetic Plastics Company, the line will be marked "Beetleware."

This colorful and serviceable type of tableware was originally introduced on the American market by the Beetleware Corporation, a subsidiary of the Synthetic Plastic Company, manufacturer of Beetle molding powders.

By having the manufacture and distribution controlled from the same source, it is possible to offer this quality tableware line at prices appreciably lower than were formerly possible.

Northern Industrial Chemical Company will carry complete stocks of luncheon and breakfast sets to be sold as units and in addition open stock in red, green, yellow and orange.

## EASTMAN INTRODUCES A MOLDED CAMERA

*(Continued from page 45)*

limited to the trigger, the sights, which are equipped with springs to permit of folding when not in use, and the film moving wheel. Metal parts, inside, are used for bracing the film rolls and to house the lens and shutter mechanism, the remainder of the camera consisting of three well planned molded parts.

One of these houses the lens and shutter and forms all but one side of the box itself. A second, easily released by means of a movable cam, forms the top of the box and the principal portion of the film holder, while a third part, attached to the second, completes the film holding frame. The small size, the clean, attractive appearance of the black molded box and the extremely low price made possible by the use of molded parts have, combined, resulted in an instantaneous and nation-wide demand for these cameras. Both dealer and consumer reactions have been uniformly favorable, and all dealers questioned ascribe this favorable reaction, first, to the convenience and attractiveness of the molded camera case as compared with previous cases in the same price range and, secondly, to the fact that for the first time a low priced camera has appeared upon the market in a form distinctly different.

## WHICH PLASTICS TO CHOOSE

*(Continued from page 62)* and overcuring is wasteful in time and results in no benefits. Tests made by the Bell Telephone Laboratories on molded $\frac{1}{2}$-in. x $\frac{1}{2}$-in. x 5-in. test bar on a typical phenolic compound showed that the molded piece had maximum strength and best dielectric properties when cured for three to four minutes, but this time naturally would vary for other materials and different section thicknesses. On pieces of certain shapes and sizes warpage may result if the molding is removed from the mold until the latter has cooled, hence cooling in the mold is sometimes advocated if warpage must be minimized. One maker of precision instruments allows molding to cool in the mold and subsequently bakes them for about 14 hours at 200 deg. F. to avoid warpage and improve dielectric properties. But such steps are rarely considered necessary and would not be taken except in the instance of a product demanding unusual precision.

*(Continued on page 76)*

Properties of Molded Phenolic Plastics

| Type of filler | Wood Flour | Fabric | Asbestos |
|---|---|---|---|
| Tensile strength, lb. per sq. in. | 6,000–11,000 | 6,800– 7,200 | 5,000–10,000 |
| Compressive " " " " " | 25,000–36,000 | 20,000–30,000 | 18,000–36,000 |
| Flexural " " " " " | 10,000–20,000 | 10,000–13,000 | 8,000–20,000 |
| Izod impact str. ft-lb. | 1.0–2.5 | 10–25 | 0.5–4.0 |
| Weight per cu. in., oz. | 0.78–0.88 | 0.79–0.81 | 1.1–1.2 |
| Breakdown voltage, volts-mil | 300–500 | 200–400 | 150–400 |
| Water absorption | | | |
| 24-hr. immersion per cent | 0.2–0.6 | about 1 | 0.01 to 0.3 |

Note: These data are based on information furnished by manufacturers of molding phenolics. Since they are for a variety of different materials under each heading, and these materials vary greatly in composition and the nature of the resin and other ingredients and their proportions, a range of values is given. In many instances there are special materials designed for special purposes in which values higher than those here listed are secured.

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RESIN DYES

## CELLULOID—GRAND-DADDY OF 'EM ALL

*(Continued from page 51)*

pments which have occurred in the past uarter of a century. The fundamental ob- ct of all these investigations may be sum- arized in the following:

To improve the quality of Celluloid. nder this classification it is necessary to t the discovery, development, improve- ent and manufacture of the following:

a. The purification and stabilization of nitrocellulose in all forms, including gun cotton.
b. Solvents.
c. Synthetic camphor.
d. Plasticizers, such as triphenyl phosphate, tricresyl phosphate, dibutyl phthalate, and others.
e. Dies and pigments.
f. Stabilizers, such as urea.

. To effect greater economies in its manu- cture with enlarged and more efficient oduction. This phase of Celluloid's de- lopment depended entirely upon engi- ers in the mechanical field. The develop- ents and improvements in the machinery cessary in the production of Celluloid ere:

a. Kneaders.
b. Converting rolls.
c. Stuffers.
d. Planers for sheeting.
e. Baking and polishing presses.
f. Extruders.
g. Seasoning equipment.
h. Casting wheels for film base.

. To promote the usefulness of Celluloid nd further its industrial applications. This ictly falls within the provinces of market- g and designing, and although consider- le has been done to acquaint industries t only with the use of Celluloid, much will pend upon the efforts of research and les organizations of plastic materials anufacturers to increase further the uses plastics in the industrial fields.

. To overcome the inflammability of Cel- oid. Celluloid's characteristic for inflam- ability may be compared in a general anner to that of a thin piece of paper or th. However, because of this very char-

W. S. Landes, president of the Celluloid Corporation.

acter of Celluloid, and because of the increasing demand for plastics in many fields where the use of Celluloid was limited, inventive minds were encouraged to engage in research for fire retarding agents, which could be used in the Celluloid itself, or for substitutes of Celluloid. Their efforts in these directions resulted in the discovery and ultimate manufacture of cellulose acetate plastic materials, phenolic resins, urea resins, casein and a host of other synthetic resinous substitutes.

The pyroxylin industry, and particularly Celluloid Corporation, looks back with justifiable pride at its undisputable accomplishments during this period. And, as one gives thought to the development of the industry, it becomes more and more apparent the important contribution that the Celluloid Corporation has made to the growth of the plastics industry. For, it must be remembered that not until very late in the last century casein, and not until 1909 synthetic phenolic resins came into use as plastic materials. The pyroxylin industry remains firmly rooted today despite the creditable achievements in competitive fields. Celluloid is still regarded as the ideal thermoplastic material, with cellulose acetate sharing all of the outstanding characteristics of Celluloid excepting that of inflammability.

Research in the laboratories of Celluloid Corporation has been fostered since the day Hyatt exclaimed "Eureka" in 1868. The achievements of John Henry Stevens, William Goodson Lindsay and the distinctive contributions of the Dreyfus brothers attest to the faithful policy of the company for constant research. Thus, the Celluloid Corporation, as the mother of this industry, continued its creative function by producing not only Celluloid but also entirely new products for applications where the use of Celluloid was not adaptable, and for other materials in allied fields.

Few people realize that while the chemists of Celluloid Corporation engaged in the improvement of the product, they also discovered solvents which made possible the lacquer industry. It was recognized by Alexander Parkes of England in the early sixties, that it was desirable to use nitrocellulose in mixing gums and plasticizers to produce varnish-like materials for protective coatings. However, the practical application of this idea had to await Stevens' disclosure in 1882 of amyl acetate (banana oil) as a nitrocellulose solvent. The discovery of this slow-drying, non-hydroscopic solvent paved the way many years later for the lacquer industry which made such phenomenal growth in the past few years.

While mention is made of the lacquer industry as an outgrowth of Celluloid, it might be well also to mention that the artificial leather industry is an offspring of Celluloid. Two outstanding products used extensively in the above two industries were contributed by William G. Lindsay, chemical director of Celluloid Corporation. These were tricresyl phosphate and synthetic pearl essence. The former is sold now under the trade name of Lindol, as a camphor substitute, and is a water white viscous liquid, odorless, tasteless, non-volatile, non-inflammable, possessing excellent plasticizing qualities for nitrocellulose. The pearl essence is sold under the trade name of H-Scale, and its discovery has made possible the manufacture of pearl articles and pearl finishes reasonable in price.

The further phenomenal contribution of Celluloid was the development and growth of the laminated glass industry. This industry, practically non-existent a few years ago, is in a commanding position today, as the use of safety glass in automobiles is steadily in- *(Continued on page 80)*

# CASEIN PLASTICS

## SHEETS and RODS

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- *Made in beautifully mottled and plain colors*

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New molded camera just placed on the market by the Eastman Kodak Company. It was designed by Walter Dorwin Teague in collaboration with the engineering staff of the Eastman Camera Works. It takes standard Kodak film of vest pocket size and retails for $1.00. Photograph by John T. Moss, Jr.

# NO LONGER SUBSTITUTES

"The designer's aim is not to make a product beautiful; his aim is to organize a product so that its appearance reveals its function, its efficiency and its value. Beauty is merely evidence that he has been successful in attaining his real object." In the foregoing statement, recently made by Walter Dorwin Teague, is epitomized the underlying reason for good design as well as the justification for its acceptance by industry.

Mr. Teague is already known to many readers of MODERN PLASTICS through his work for such organizations as Taylor Instrument Companies, A. B. Dick Company, National Radiator Corporation, Corning Glass Company and many others. His design of fifty streamlined and air-conditioned passenger coaches for the New Haven railroad is among his recent accomplishments.

With respect to the possibilities of plastics in the field of design, Mr. Teague has the following to say: "It is my belief that the development of plastic molding compounds is one of the most important factors in present day industries, and that these compounds will be one of the principal resources of the industrial designer. "The start of their career was handicapped by their being put forward as cheap substitutes for other materials. This is a wholly false conception, since they have potentialities possessed by no other materials and beauties peculiar to themselves.

"It has always seemed to me that limitations should be studied as much for the opportunities they open up as for the restrictions they impose. Experience has shown that certain forms when molded give a better effect than others—that is, curved surfaces in molding compounds are almost invariably more pleasing than flat surfaces or sharp angles. The designer who bears this in mind will get a better result than one who attempts to impose on materials forms for which it is not adapted. However, if the cost permits special treatment of the molds, and perhaps a rubbing operation after the form leaves the mold, flat surfaces can be used with very striking effects.

"Such facts as these, the designer needs to bear in mind in planning his use of molding compounds, and if he is familiar with the technical processes involved, he will undoubtedly discover many applications in which the materials have not previously been used."

Seats in the 50 new Pullman coaches designed by Walter Dorwin Teague for the New Haven Railroad will be of metal tubular construction with arm rests of molded Bakelite. Seats will rotate, and great care has been taken to develop them along the lines of maximum comfort. The detachable seat cushions will be upholstered in a short pile mohair of deep blue, and the molded arm rests are black. Mr. Teague is shown trying out one of the seats in his studio. Photograph by Frederick Bradley.

# MAKALOT

*"The Universal Molding Compound"*

After molding several hundred thousand articles varying in size from a few grams to two pounds each using the Standard grade of MAKALOT, the Superintendent of one of the largest molding plants in the country stated that MAKALOT was the nearest to a Universal Molding Material he had ever seen.

Some of the MAKALOT Specials listed below may be of interest to you.

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|---|---|
| No. 75-D | All mineral High Heat. Will not stick or stain. |
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| No. 83-R | Long flow for intricate jobs. |
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| No. EM-1040 | Low Loss natural color. |
| No. EM-1041 | Low Loss for Short Wave Radio Parts, etc., in colors. |
| No. EM-1010 | Arc Resisting in Black and Brown for Distributors, etc. |

# RICHWARE

The beautiful pastel phenolic in lustrous and brilliant colors. Its great strength and perfect resistance to boiling water makes it the ideal molding compound for dishes, caps, toilet articles, etc. RICHWARE is tasteless, odorless and will not deteriorate with age.

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# FORMALDEHYDE
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# HEXAMETHYLENAMINE

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# DENTAL HYGIENE THROUGH PLASTICS

Advertisements—newspaper, magazine, billboard and radio—have made young and old conscious of the fact that clean teeth are essential. There is this and that dental cream or powder which offers some advantage or other; ditto, the various tooth brushes—to say nothing of the admonitory advice which pleads that one should make a friendly (?) call on his or her dentist at regular intervals. Universally, Americans are credited with having good teeth—but there is something to be said on behalf of those who encourage us to keep them that way.

Millions of dollars are being spent annually to educate the public in the practice of dental hygiene. But, to be properly consistent with this doctrine, it is logical to ask what measures of protection we are adopting to assure cleanliness of the "instruments" which we use daily to brush our teeth.

While modern bathrooms are considered very sanitary, they are far from being germ-proof and dust-free. True enough, when one buys a brush, it usually is sterilized and in a perfectly sanitary condition—germ-free and healthful. So we place it in an open rack, on a shelf or in a glass, and there it reposes for, say twenty-three hours and fifty minutes every day—exposed to dust, contamination and odors. It must be admitted that we are somewhat inconsistent in our theories or practices of hygiene!

The use of plastics for bathroom fixtures and appurtenances is not new. There are already countless applications in evidence, but probably the newest of these is that in which we find the protection that is necessary to complete our program of dental hygiene.

Koleda Products, Inc., of Buffalo, N. Y., is the manufacturer of the Koleda Tooth Brush Guard, a reproduction of which may be seen in the accompanying illustration. Not only is the device a commendable one, from the standpoint of convenience and sanitation, but it also presents a pleasing appearance. The milk-white Plaskon base and crystal-clear glass dome will harmonize with any bathroom equipment.

As may be seen, the assembly permits the placing of four tooth brushes, so arranged that each is protected from germ-laden air and from contact with the other brushes—each within its own ventilated compartment where it becomes dry and is constantly being treated with a pleasant antiseptic aroma.

To clean, the glass dome is turned slightly to the left and removed, and this permits access to the separators, the antiseptic vial and the rubber disc. The base and bracket, which are held in place by means of a metal anchor plate fastened to the wall, are also removable.

The guard is the invention of Edward H. Koch, president of the Koleda Company who has been granted a design patent on the device. The Plaskon base and bracket was molded by Norton Laboratories, Inc. Here, again, we see an instance in which plastics are functioning usefully for a new product which can be predicted to have a wide acceptance. It is quite in the scheme of our modern living that cleanliness and beauty should take the place of outmoded ways, and it is in this direction that these materials will continue to win increasing favor.

## RUBBER "SANDWICHES"

One who satisfied his inner man with rubber "sandwiches" would likely pay for his indiscretion immediately. But in the rubber sandwiches which the Synthane Corporation, Oaks, Pa., makes there is "something to chew on"—especially for the engineer or product designer. Sheets of Synthane laminated Bakelite and rubber are bonded together alternately to combine the extreme resiliency of rubber with the strength, rigidity and desirable electrical and solvent resisting properties of Synthane. The number and thickness of the individual layers may be varied indefinitely to produce a section of any given thickness or characteristics.

Possibilities for the new material readily suggest themselves, particularly where quietness and strength are significant factors; as for example, vibration absorbing mountings for motors in electric refrigerators, washing machines and fans. Or as trays or tables in restaurants where the surface must not only be beautiful and stainless but absorb the clatter of dishes as well. Many other applications will undoubtedly be discovered.

Domestic

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—Yet Up-to-the-Minute in Equipment and Service

**Molders of the new compound**

## HARVITE

•

## THE SIEMON COMPANY

**Bridgeport** **Connecticut**

# NEWS AND DEVELOPMENTS

American Catalin Corporation, manufacturers of cast synthetic resins sold under the trade name Catalin, have appointed H. Krehbiel sales manager in charge of all domestic business.

Edward Rosendahl, technical adviser of the Glyco Products Company, Inc., Bush Terminal, Brooklyn, N. Y., has been appointed vice-president and general manager as of September 1, 1934. Mr. Rosendahl is a graduate of the University of Manchester, England.

Joseph C. Rah & Company, 5745 W. Ohio St., Chicago, Ill., announces an engineering service exclusively for manufacturers. Those services of special interest are: material and process engineering; electrical insulation design; mechanical and electrical design; styling; chemical engineering; research, development, and special problems.

HAROLD I. HILL

Harold I. Hill, vice president in charge of films and sales for the Celluloid Corporation, Newark, New Jersey, died on August 17, in the Maine General Hospital, at Portland, Me. He had been in Maine for several weeks in an effort to recuperate from a recent illness.

Mr. Hill was born in Reading, Pa., on Oct. 12, 1897. He was a graduate of Burlington High School and the Wharton School of Business of the University of Pennsylvania. He was a public accountant in New York prior to joining the Celluloid Corporation in 1926 as assistant treasurer. He had lived in Montclair, N. J., since 1926 and was a member of St. John's Episcopal Church and of several business groups in New York City. His wife, Ann Grasset Thomas Hill, two sons, his father and mother, Mr. and Mrs. D. Irving Hill, and two brothers survive.

Celluloid Corporation announces the following changes in the organization of its sales department, effective Sept. 1, 1934: George H. Boehmer, who has been with the company for twenty-four years, has been appointed general sales manager; R. S. Gavitt succeeds Mr. Boehmer as director of sales of the Sheet, Rod & Tube Division; E. W. Ward succeeds Mr. Gavitt as district manager of the Chicago office.

## TENNESSEE VALLEY AUTHORITY

The government's development of electricity through the harnessing of water power throughout the great river valleys of the country may be unfortunate for existing private enterprises in some instances, but it should bring cheaper electricity and make it available for thousands who have yet little acquaintance with the conveniences and labor-saving that electricity is capable of supplying.

The TVA (Tennessee Valley Authority), whose two huge dams costing $72,000,000 are under construction and others planned that will bring this one development to a total figure of something like $300,000,000, convey some idea of the magnitude of the government's program.

With the Tennessee Valley, the Columbia River and the Mississippi and other projects, there is going to be plenty of electricity to dispose of eventually.

These vast projects for the development of electrical power, of which the TVA is the most advanced, will increase many fold the use of things electrical; as small motors, washing, ironing, sewing and other household machines, also heaters, stoves, refrigerators, percolators, toasters, ironers, vacuum cleaners and air conditioning units. It should multiply the use of small industrial motors a thousand times over. Beyond this there are the larger manufacturing and municipal applications. A tremendous new market will be created for the moderate priced electrical device of every sort.

There is and will be controversy on the part of manufacturers and sales set-ups, as in the instance of the TVA, or rather the FH & FA (Factory, Household and Farm Authority), experienced in the development of a low-priced electrical refrigeration program. Without entering into this controversy, there is no doubt that the wind created by the government's program is not an ill wind for the plastic industry.—From the September, 1934, issue of *The Durez Molder*.

## LITHOLITE

A special process of applying lithographed pictures, trade marks or art work of any kind and in any color to molded phenol resin has been developed by the E. E. Fairchild Corporation, Rochester, N. Y. In all advertising and sales presentation the product is referred to as Litholite, the trade name created for it and owned exclusively by that company.

In Litholite—samples of a tray and coasters are shown in the accompanying illustration—the color work is an integral part of the product, which is impervious to alcohol and other injurious substances, as well as being fireproof for all ordinary purposes.

The process lends itself to the entire field of display work, packaging and products in which color reproduction is desirable. The tray and coaster set, the first item produced, has been placed in depart-

ment stores and gift shops and has sold most satisfactorily. At the present time, small signs for inside displays, trays and coasters are being produced for the brewing industry. The molding of the items shown was done by the Northern Industrial Chemical Company.

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**HIGHEST BRILLIANCY**

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*Importers*

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*The Newark Die Co.* has specialized for sixteen years in the engineering and manufacture of molds for plastic materials, in Die Sinking, Engraving and Hydraulic Hobbing. Keller-equipped, ours is one of the most modern and best equipped shop in the state.

Place your die making problems in the hands of this experienced, well recognized and financially responsible concern.

*Newark Die Co.*

INCORPORATED

24 SCOTT ST. NEWARK, N. J.

# CELLULOSE FINISHES FOR LEATHER

The Editor;

Sir:

We have read with interest the abstract from the *Leather World* as published in the July issue of *Plastic Products* regarding Lindol.* We do not find anything indicating that Lindol is objectionable in lacquers used for finishing leather. It is true that Lindol will discolor when exposed to sunlight or U V light but this objection holds true for most of the plasticizers and softeners used. It is particularly true of castor oil.

Such books as "Chemistry of Leather Manufacture" written by John A. Wilson in one of the American Chemical Society's Monograph Series, cites tricresyl phosphate as one of the plasticizers which may be used. S. P. Wilson in his book, "Pyroxylin Enamels & Lacquers," highly recommends tricresyl phosphate. Many other references such as "A Survey of Nitrocellulose Lacquers," by B. K. Brown & F. M. Crawford, "Physical and Chemical Examination of Paints, Varnish & Lacquers," by H. A. Gardner, can be cited. Furthermore, Lindol has been used in pyroxylin lacquers since they were introduced in 1924 in increasing amounts and has not been found objectionable; as a matter of fact, it has displaced other chemical plasticizers in many instances. It is only second in the quantity used to dibutyl phthalate, and this has been due mainly to the price differential.

It will discolor considerably more if used with zinc oxide but with titanium dioxide the discoloration is very slight and certainly not to the extent of being objectionable on leather. It may also be used with zinc sulphide which we understand is now obtainable as a very pure and white stable pigment. Seventy-five parts of titanium dioxide and twenty-five parts of zinc oxide make a good pigment combination for use with Lindol. Lithopone is now being used in large quantities as a pigment in paints, varnishes and lacquer enamels and this is suitable for use with Lindol. Research work has disclosed that many defects and imperfections in lacquers are due to improper formulation and the use of materials which, when mixed together, result in an inferior product. All the materials that we know of which are used constantly are deficient in some respect, but by careful selection and proper formulation, a very durable and stable lacquer can be made. We have sold this material to leather manufacturers in the past and we have never received any criticism from any of them.

Tricresyl phosphate is used as a plasticizer and fire retardant in all types of lacquers and coating materials, such as automotive, industrial, furniture, wood lacquers, aircraft dopes; also dopes for genuine and artificial leather and insulating materials, as well as a softener in synthetic resin coatings. It is used as a waterproofing agent in coatings for treating textile fabrics. It is a colorless and odorless liquid which is very stable in storage. It does not freeze, although it becomes very viscous at temperatures below —40 deg. C.

It reduces appreciably the inflammability of lacquer films in which it is used. This quality is of value for special application. It has a high boiling point and low vapor pressure so that it will remain in the film and maintain its plasticizing effect at elevated temperatures. For this reason, its use is particularly advantageous in lacquers which will be subjected to prolonged exposures, at temperatures above 60 deg. C., where more volatile plasticizers will gradually evaporate and non-solvent oils will sweat out of the film. At low temperatures films plasticized with tricresyl phosphate will not lose their flexibility and become brittle. Thus tricresyl phosphate imparts sufficient elasticity and other properties necessary to meet unusual conditions, such as contraction and expansion due to extreme temperature changes.

Tricresyl phosphate is not only an excellent solvent for nitrocellulose but for cellulose esters, oils and most resins, which permits of the formulation of high solid content lacquers resulting in good film build without weakening the film. This also permits of a wider latitude in formulation and adjustment of resins, pyroxylin or other ingredients to meet any other requirements. It does not retard the setting of the film, due to solvent retention, nor does it remain soft or tacky.

The use of tricresyl phosphate as a plasticizer assists in securing good gloss and flow, low moisture permeability with good adhesion and with all types of resins, natural and synthetic, tricresyl phosphate plasticized lacquers dry quickly to a hard, smooth, durable, homogeneous film.

Abrasion tests show that the film will withstand severe service but is not so high as to be difficult to sand and polish. It aids the flow, simplifies the correction of blushing and produces a film with a hard, non-marring surface which is capable of high polish.

In pigmented lacquers it reduces chalking to a minimum. It is stable and inert toward most pigments and other lacquer ingredients. It has a high dielectric constant so that it may be used to advantage in insulating materials. Like triphenyl phosphate, it will gradually darken on prolonged exposure to light, however, if the lacquer is properly formulated by using resins and pigments which are opaque to actinic light, the discoloration may be greatly minimized. Tests have shown that discoloration is very slight in clear films, and no greater than dibutyl phthalate, when certain types of synthetic resins are used, such as the Rezyls. Tricresyl phosphate, because of its oil, non-volatile properties and the readiness with which pigments disperse, is well adopted for the grinding of pigments. Pigments so ground give trueness of color and a higher lustre to the lacquer finish.

As much as 10 per cent tricresyl phosphate in shellac imparts beneficial properties, the most important of which is to increase the water resistance. Flexibility is also increased and adds to the life of the film.

G. H. Boehmer
General Sales Manager
Celluloid Corporation

New York
Sept. 5, 1934

* The article referred to appeared on page 16, "Cellulose Finishes for Leather." Tricresyl phosphate, commercially known as T.C.P., Plastic X and Lindol, was credited in the article as having the disadvantage of being easily affected on exposure to light. "This," concludes the article, "is a somewhat disastrous defect, especially when the application is made to light colored or white leathers; indeed, its application to any leather results in a material alteration in color when the leather is in use, and consequently is of course, objectionable."—Editor.

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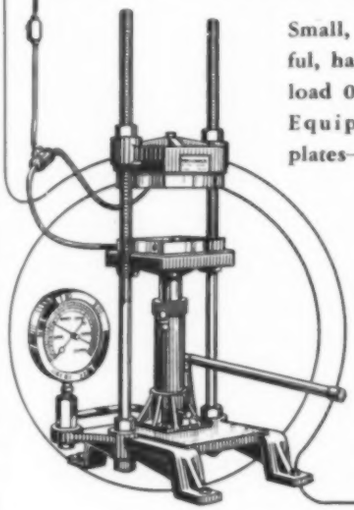

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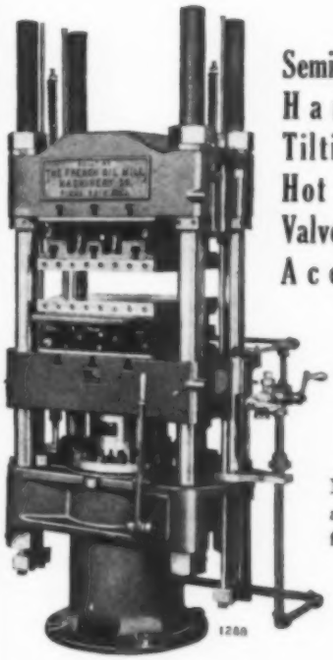

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Senior partner of Van Doren and Rideout, industrial designers; graduate of Williams College; studied at Art Students League and under private teachers; exhibited at National Academy of Art and abroad; official lecturer in English, Louvre Museum, Paris; assistant director of the Minneapolis Institute of Arts. Such is the training and experience of the

HAROLD L. VAN DOREN

author of the article, "A Designer Speaks His Mind." The sketches and photographs illustrating Mr. Van Doren's story are instructively representative of the work done by the studio of this able partnership.

Helen Ufford, associate editor of *Delineator*, offers some exceedingly pertinent observations in her article "A Hostess Looks at Plastics" which should be of constructive assistance to designers and molders. Miss Ufford's views, from the consumer's standpoint, as expressed in her contributions, are always stimulating.

N. S. Stoddard directs sales promotion for the Plastics Department of General Electric Company.

Carl J. Begemann is responsible in no small measure for the success of Glolites and Lektrolites. He is advertising manager of Platinum Products Company, Inc.

John P. Bolin whose article "What Price Molded Parts?" is the first of a series of, shall we say, *caveat emptor* stories, is a member of the sales staff, Chicago Molded Products Company.

George H. Boehmer, twenty-four years with the Celluloid Corporation, has recently been appointed its general sales manager.

Franklin E. Brill "contrasts" plastics in a constructively favorable manner in such writing as he does for the industrial press. His association with General Plastics, Inc., and with the making and utilization of Durez is well known to most of our readers.

Herbert Chase has already been introduced. Turn to page 56 and you will learn that he commences, with this issue, a series of articles that will be helpful in determining "which plastic."

## SYNTHETIC MOULDED PRODUCTS, INC., ENGAGE WILLIAM LONGYEAR

William Longyear, designer and head of the course in product and container design at Pratt Institute, Brooklyn, N. Y., has been engaged by the Synthetic Moulded Products, Inc., of Stonington, Connecticut, as consulting designer. This arrangement will not affect Mr. Longyear's position at Pratt where notable work in packaging and industrial design is being taught.

Synthetic Moulded Products, Inc., has equipped its plant especially for quality production. The company's machinery and presses represent the newest and finest equipment available.

## NEW PLASTIC COMPOUND COMBINES FINE APPEARANCE WITH GOOD HEAT RESISTANCE

A new grade of Cetec, cold-molded, designated as No. 1389 and intended especially for insulating applications that must have both good heat resistance and fine appearance, has been announced as a new product of the Plastics Department, General Electric Company, Lynn, Mass. It is said to be particularly well-suited for such applications as electric-iron heat-control knobs, cord-connector plugs, etc. In addition to its smooth, finished surface which is unusually attractive for a cold-molded compound, the new material is said to combine a number of characteristics which make it adaptable to a wide range of uses. It is unaffected by temperatures up to 480 deg. F. It has high dielectric strength, 120 volts per mil, and its transverse strength is 6000 lbs. per sq. in. Moreover, the compound is practically water-proof, the water-absorption rate being but .35 per cent in forty-eight hours. Because the material is molded to shape at room temperature, and then heat-treated to impart strength and toughness, it offers the advantages of lower unit cost and reduced mold investment—particularly for relatively small production quantities.

## WHICH PLASTICS TO CHOOSE

*(Continued from page 64)*

Ordinary phenolic compounds are molded as a rule, at 2,000 to 2,500 lb. per sq. in. pressure and a mold temperature of about 300 deg. F., but higher pressures are often used for special materials, as much as 9,000 lb. per sq. in. having been used with fabric-filled materials. Higher temperatures, up to 350 deg. F., may decrease curing time, but may produce discoloration in light-colored materials.

Section thickness as low as $^1/_{32}$ in. are sometimes molded and thicknesses up to one inch or more can be molded if sufficient curing time is allowed. Where close dimensions are essential, they can often be held within plus or minus 0.002 in. per in., but the recommended allowance is plus or minus 0.005 in. per in., as this tends to increase the speed of molding and to reduce the number of rejected parts, and consequently to reduce cost.

## A CLOUD NO BIGGER THAN A LADY'S WRIST

*(Continued from page 29)*

who planned them but upon synthetic jewelry as a whole. Thus, in one instance, the buyer of a large New York department store has definitely declared that should one large metal or glass manufacturer produce a wide line of well planned costume jewelry there *might* be a definite switch in the vogue for such jewelry, away from the synthetic field.

Is the picture then as black as at first glance it might seem? The answer lies largely with the manufacturer of synthetic jewelry. If these manufacturers, as a group, follow women's style trends closely, secure the services of even more competent designers than they have used to date, restrict their production

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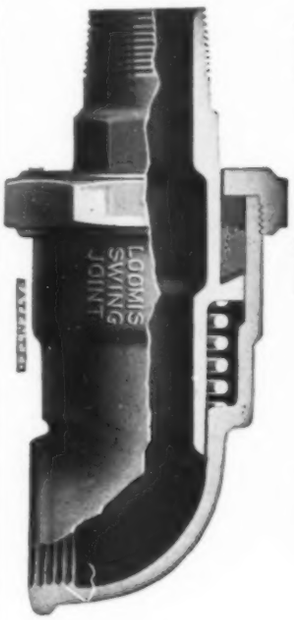


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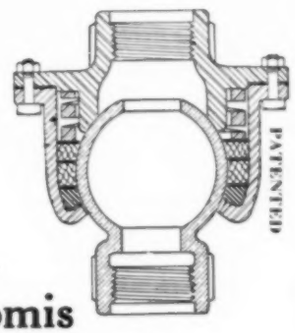


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solely to well planned articles and, most important, take definite action to prevent style piracy and the cheapening of designs—if all these things are done then synthetics will not only maintain their present position but will firmly establish a permanent vogue. If, however, present tendencies in the opposite direction should not only continue but grow, then cast-phenolic jewelry is destined to become a cheap and a shortlived fad.

## WHAT PRICE MOLDED PARTS

(*Continued from page 21*) carefully made mold require less hand finishing than those from poorly finished molds.

All molded pieces come from the mold with some fin or flash of material where the mold sections meet. Various methods are employed to remove this fin, such as filling, sanding, grinding or tumbling. Sometimes holes have to be drilled and tapped instead of molding a thread into the piece; sometimes a metal insert is molded into the piece instead. Sometimes a still finer finish than that imparted by the mold surface is desirable (as for example a radio cabinet, a clock case, cigarette box or toilet article), and then polishing or buffing is necessary. As all such operations call for additional labor and so add to the cost, special finish should not be asked for if mold finish is sufficient. Inquiries should specifically state whether mold finish or polish finish is desired, and quotations should just as specifically state which finish will be furnished to the customer.

There are various kinds of molding materials developed for special purposes or to meet unusual conditions; materials to resist excessive heat or moisture; materials that are highly shock resisting or that have unusually high lustre. Such special materials cost more than the standard materials and require longer "curing" or molding time. Some special materials require a different mold construction than the standard materials due to the difference in their bulk factors.

Requests for quotations should specify allowable tolerances for all dimensions, but they should not specify closer tolerances than are necessary and the purchaser should make sure that the quotation covers the tolerances he specifies.

If a purchaser is in doubt as to the adaptability of a part or piece to plastic molding, he should consult a reputable molder before going ahead in the design of the part. The larger plastic molding plants offer skilled engineering service. Many of their salesmen are either engineers or have had experience as molders and can ably assist or advise a prospective user of molded parts, if allowed the opportunity. Plastic molders as a whole maintain high standards and the purchaser need have no compunction about taking them into his confidence nor worry about their disclosing anything to his competitor, under any conditions.

## YOU'VE GOT TO GET CONTRAST

(*Continued from page 54*)

out and show the lustre, while flat, smooth, undecorated surfaces show no high-lights.

High-lights are a very valuable tool to the plastics designer, especially on black phenolic pieces. Usually they occur uninvited, sometimes in the wrong place, sometimes too often. If you seek them and organize them, they are to the plastics designer what windows are to the architectural designer. Treat them carelessly, letting them fall where they may or not at all, and you have a messy object in which high-lights may oppose each other to give an impression as confusing as a roller-coaster trestle. Gather them together and treat them carefully like brush or pen strokes, putting them where they'll contrast with the smooth plastic surface, and you get a richer, more pleasing whole.

You can get them in a number of ways: By scoring the mold, by cylindrical, spherical or conical shapes, by set-backs in a flat surface, by beads, ribs, flutings or by engraving designs in the mold. The last-named smacks of "added decoration" and since it gives greater opportunities to go haywire, it should be used as a last resort. And remember, high-lights can be abused as well as unused.

Besides their use for contrast, high-lights can be used to make an object optically smaller or larger, lighter or heavier. Take the case of a molded pocket projector, or a check-writer, or an adding machine: a sharp edge at the top will place the high-light at the extreme outside of the top, making it look larger. A rounded edge brings the high-light in to the point where the top starts to curve down, making it look smaller. These same high-lights can take the heavy look from slightly elongated cube-shaped objects. There isn't much contrast between the dimensions, so parallel bands of ribs or grooves running lengthwise catch high-lights and serve to lengthen the object—optically at least—and give an impression of greater lightness.

In any plastics design problem, don't depend on sketches to visualize the final result. No artist can portray three dimensions adequately on two dimensional paper. Sketches serve to visualize forms only: clay or cardboard models are better for experimenting but best of all are machined wood or cast-plastic models. Only in solids can we note that fascinating lustre and sleekness which is plastics' most precious asset. Rule Number One for plastics-users might well be: Don't order molds till you've tested models.

## INTERCHANGEABILITY

(*Continued from page 20*) produce a line of switches, outlet and pilot lights small enough so that three of any of the devices could be installed in a single gang box presented many difficulties. Never before had a 10-ampere switch been condensed into such small proportions. Never had outlets been designed so that three might be assembled together. Ingenuity and experience made possible this pioneering.

The flexibility and versatility of the line seem destined to create new uses for wiring devices. At the front door of a residence may be installed a night light to illuminate the bell push and name plate bearing the owner's name. Or in the kitchen a double outlet to supply current to the electric appliances may be installed with a pilot light to warn that the toaster has been left burning. Or in the upstairs hallway a combination of a night light controlled by a switch to light the footsteps of a week-end guest traveling late at night toward the bathroom, and an outlet for connecting the vacuum cleaner may be used. Hundreds of new uses for wall plate merchandise adding to the convenience and comfort of the home will be commonly employed by contractors.

To date the results have justified every hope of the manufacturers; jobbers and dealers have welcomed the line with open arms; sales to consumers have been more than satisfactory; and competitors have recognized the value of the entire simplification program and are being licensed to

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use the Despard plan. In the Tennessee Valley experiment the Government has recognized the thoroughness and soundness of all angles of the line by recommending its universal use. A new standard for electrical wiring evolves, and modern plastics serve to a greater degree than ever before.

## CELLULOID—GRAND-DADDY OF 'EM ALL

*(Continued from page 66)*

creasing. Needless to say the Celluloid Corporation has taken out numerous patents to protect its findings in this field. As early as 1909, the Celluloid Corporation, in its endeavors to reduce the inflammability of Celluloid, discovered the practical uses of cellulose acetate as a base for the manufacture of thermoplastic materials. It was not, however, until 1909 when the first real commercial attempts to make non-inflammable cellulose acetate film base were started by the Celluloid Corporation. Until 1926 the use of cellulose acetate was confined by Celluloid Corporation to the manufacture of non-inflammable film base, known in the trade as Protectoid or "Safety Film." The work of Lindsay, although notable in this particular field, did not bring the full realization of this wonderful basic material until the two brothers, Camille and Henri Dreyfus, offered to the industry the fruits of their famous researches in cellulose acetate. It was therefore late in 1926 when the production of cellulose acetate molding powders, sheets in varying thicknesses, rods and tubes in an unlimited range of colors was introduced under the trade name of Lumarith. Cellulose acetate's basic raw material is cotton, as in celluloid. Cotton is combined with acetic anhydride, acetic acid in the presence of catalytic agents. This combination of chemicals with cotton forms cellulose acetate as the basic material out of which sheets, rods, tubes, molding powders and foil are made. The mechanical process of manipulation and introduction of plasticizers, solvents, pigments, and dyes is practically the same as that in the manufacture of celluloid.

The introduction of Lumarith plastic materials by the Celluloid Corporation opened entirely new avenues in the use of molding materials which heretofore had been limited in their color range. Lumarith sheets, rods and tubes soon increased the uses of plastic materials where the use of Celluloid was either inadvisable because of its inflammable character or because other competitive materials, although non-inflammable, due to their lack of thermoplasticity, brittleness, etc. were not adaptable. The Celluloid Corporation's contribution to the industry in the introduction of cellulose acetate plastic materials was phenomenal. It placed a new milestone in the development of the industry by offering a material which ranging from an absolutely clear transparent could be had in an unlimited range of colors with the most intricate configurations. Here was a real thermoplastic material which could be had as non-inflammable and at the same time suitable to stimulate all kinds of precious stones and rare woods.

The full utilization of cellulose acetate plastic materials, however, was not accomplished until the Celluloid Corporation introduced, in 1931, a crystal clear transparent wrapping paper under the registered trade name of Protectoid, especially adaptable for the packaging field. Here again the Celluloid Corporation filled a long-needed demand by offering a material which was non-inflammable, shrink-proof, tough, water-proof, grease-proof, vermin and rodent-proof.

Although the Celluloid Corporation is engaged principally in the manufacture of nitrocellulose and cellulose acetate plastic materials, it nevertheless has followed the policy of keeping abreast of all new developments and requirements of the plastic industry. So, it is with interest that the Company has embarked recently in the manufacture of a synthetic cast phenol formaldehyde resin to be sold under the registered trade name of Ivaleur.

Already manufacturing facilities have been installed in the ample acreage of buildings of the Celluloid Corporation at Newark, N. J., for the manufacture of this new product. Ivaleur will be provided in the form of sheets, rods and tubes. Although materials of the phenol formaldehyde type are known to the trade to be brittle compared to Celluloid, the company nevertheless is producing an improved type of cast phenolic material. This new development is in line with the consistent policy of the company to contribute either something entirely new or to improve already existing materials.

Ivaleur may be described as a material rather hard but easily machined or tooled, but not remoldable like Celluloid or Lumarith. It is tasteless, odorless, absorbs no moisture, resists alcohol, oils and all common acids. It is not subject to static and has a high dielectric resistance, good insulating properties, stands up against heat and is not inflammable. One of its best characteristics is that it has no shrinkage. Therefore, it is an excellent type of material for precision articles. Ivaleur can be had in clear transparents and in a wide range of deep colors, lending itself to beautiful lustrous finishes. The uses to which Ivaleur can be put are almost unlimited. It is an excellent type of material for the electrical, novelty, jewelry, cutlery and many other industries.

## WITH REFERENCE TO LAMINATED SHEETS

*(Continued from page 41)* undeveloped, the larger manufacturers of laminated plastics maintain extensive developing laboratories and a staff of application engineers whose services are offered free to all industries to help them determine the use of applying plastics to their products.

Certain of the above properties and combinations of properties are unique with the phenolic laminated sheets. For example, it will be noted that the density is just half that of aluminum and that the specific strength or strength for unit of weight, which is important in the construction of certain devices, is extremely high as compared to other structural materials. It will also be noted that the modulus of elasticity of the laminated materials is much lower than that of any of the metals. It is about one-fortieth that of steel. This combination of strength, with the low modulus of elasticity, gives the material its great importance in the design of machinery that embodies rapidly moving parts which are subjected to impacts.